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EUROPE AND AMERICA.

One of the most able and interesting treatments in late years of the industrial changes of the time and the commercial relations between Europe and America is that found in Mr. Andrew Carnegie's recent address as rector of St. Andrew's University, Edinburgh. In many respects, it is but an amplified and more forcible exposition of views already advanced by the great steelmaker, and summed up in his recent "Empire of Business." But some new points are brought out, and new suggestions made; perhaps the most startling of which is that the Kaiser should consolidate Europe industrially and put himself at the head of the "combine." It is rather hard to imagine such a performance, but probably it would be even more difficult to carry out. Moreover, the object proposed by Mr. Carnegie is that implied in his title, "Europe versus America," and there lurks the main fallacy of his remarkable address, for the peace, prosperity, comfort and happiness of the world depend upon Europe *and* America. There need be no "versus" about it. In fact, there cannot be. No one country can do all the business, for if it did, the other countries would have no purchasing power left. There is a popular coon song: "If you don't have no money, you needn't come around," and that applies to international affairs as well. You cannot carry on trade with a people who have neither cash nor products left.

A pertinent point made by Mr. Carnegie is the importance of magnitude or quantity, in cheapness of production. This is, of course, an old and obvious idea, but he associates with it the corollary that it gives control of the home market and a grip on the foreign one. But, if on the other hand, the foreign market is highly protected, and if, in addition, automatic machinery that unskilled labor can play with, is introduced elsewhere, ability for colossal output may go for little. It is not to be denied that the tendencies of the time are against small markets, minor nationalities, "dead languages," eccentric forms; and equally in favor of concentration, combination, consolidation. But so far as we can see, the centrifugal forces still remain operative in ways that may be obscure but are none the less pronounced. If all the world looked alike, made and wore the same clothes, ate the same foods, used the same speech, thought along the same lines, voted the same ticket, and was just America, it would be about the dullest, most dismal and altogether insipid universe imaginable, to be escaped from at the first opportunity. But, happily, there will remain great differences among mankind, with resulting varieties of production and varieties of wants; and export trade and import trade will both flourish, while the traveler will ever be greeted by something new and strange to please him when he goes abroad.

TECHNICAL EDUCATION IN GREAT BRITAIN.

That technical education has been in a woeful state in Great Britain has been apparent not only to observers from other countries but also to the more enlightened Britisher. This situation appears to be partly, and perhaps largely, due to an unwillingness to depart from the methods of training which prevailed when all the world acknowledged the manufacturing supremacy of the British Isles, and when her engineers had world-wide reputation. During this period the engineer was almost necessarily a man of practical antecedents, for then engineering was little systematized and largely a matter of precedent, its advances being due to extraordinary ability on the part of a few rather than to any direct influence of scientific teaching. Since then, however, conditions have greatly changed. The

wide gulf which formerly separated science from engineering has been bridged. Engineering advance is no longer dependent on the intuition of great minds but proceeds apace with scientific discovery which, receiving form in the laboratory, passes quickly to the shop. The transition was duly recognized in this and some of the continental countries. Courses of technical education are now included in the curricula of almost all the important American schools, and specific technical schools are scattered about the country. As a consequence, at the present day the entire younger generation of engineers are men who have been specifically trained to meet the new condition.

At the present time the situation above referred to appears to be receiving serious attention in Great Britain, and particularly in the provincial manufacturing centers. We recently referred to the excellent electrochemical course organized at Owens College, Manchester, and the municipality of that city has just established a municipal school for higher technical education. In an address at the inauguration of this latter school, Premier Balfour went to the heart of the question when he said that the traditions of the great British manufacturing establishments are that the place in which to learn is not the lecture room, but the shop; not at the feet of skilled professors, but actually among the artisans who are carrying on an industry. While acknowledging that there may be a great deal of truth in this, the Premier said he felt that they would drive the truth too far, and that however sound the instinct might be that lay at the bottom of it, they were working it too hard at the present time, and if they really did mean to turn the brains, muscles, enterprise and the inventive ability of their countrymen to its best purpose, it was necessary to place among the directors of industry those who had not merely practical knowledge. They must give them, in addition, that complete scientific training which has become the basis of the whole industrial fabric. "True theory and true practice," he said, "can never be divorced without loss to both, and the ideal for which they had to strive was not that of simply imitating the process of those who went before, but imitating their energy—their anxiety to take the best the world had to give—the world both of practice and theory, in the changed and changing conditions of our time." This opinion by one whose views command attention not only as the utterance of an exalted official personage, but as the expression of a brilliant mind, should have no little influence in advancing the cause of technical education in Great Britain.

STARTING RESISTANCES.

An interesting paper on this subject by Mr. A. E. Gott has recently been published in the journal of the British Institution of Electrical Engineers, although it was read before the Newcastle Local Section in January last. The importance and value of a starting resistance for a direct-current motor increase rapidly with the size and capacity of the latter. A very small motor needs no starting resistance at all; while a large motor cannot be started at full pressure without one. Not only must a starting resistance be used, but it must also be graded carefully, with reference to the nature of its duties, in order to start its accompanying motor smoothly. It is not at all uncommon to find a large motor which accelerates very irregularly by reason of defective grading in the successive steps of its starting resistance. The paper referred to discusses the proper design of such resistances in order to obtain the best conditions for starting. The rules are capable of very simple algebraical expression, based upon Ohm's law, with the assumption of complete establishment of the c. e. m. f. in the armature at each step, before the next resistance step is cut out. But the numerical computation of the results for any particular case may be quite lengthy.

The use of water rheostats for starting is extending, and the difficulties they usually present are the introduction of too little resistance at the start, and too much resistance left in near the end, whereby there is apt to be an initial jerk of the armature at first start, and a final acceleration jerk when the water-starting rheostat is removed. It is shown how these difficulties may in large measure be removed by suitably shaping the vessel and electrodes of the water rheostat and by the judicious use of enamel as an insulating coating upon parts of the rheostat walls. The great advantage of a water rheostat is its power of absorbing energy without exceeding the temperature of boiling water. So long as there is enough water left to boil away, the energy is absorbed in gasification. A resistance grid of metal may get red hot by overwork, and may disintegrate, whereas a water rheostat can only boil away so long as water is supplied to it.

STUDIES OF ILLUMINATION.

The Institute papers of Messrs. Matthews, Sharp and Burnett show that the important subject of illumination is beginning to receive something like a proper amount of attention from engineers. The first-mentioned paper is of great practical interest in presenting a useful, even if somewhat complicated apparatus for obtaining directly mean spherical candle-power. This quantity while manifestly affording the only rational basis of comparison between lights, has heretofore been so inconvenient to determine that it has generally been regarded as of only theoretical interest, while really it is of unique practical importance; for measurement of mean spherical candle-power provides the only standard of comparison which cannot be evaded. So long as incandescent lamps are rated on any other plan, they will be given characteristics such as to exaggerate their efficiency in the conventional scheme of measurement. One cannot, however, increase the mean spherical rating without increasing the luminous flux to a corresponding degree, and consequently the energy supplied to the lamp. Professor Matthews' form of integrating photometer ought to do good service in simplifying the generally troublesome measurement, and so bring mean spherical candle-power within the range of the practical tests to be applied to lamps in commercial work. Its value obviously depends on the accurate determination and integrity of the mirror constants, since the process of integration is merely the physical summation at the photometer disc of light radiated in various zones. Whether the apparatus in practice can be kept in reliable working order is a thing that only experience can prove.

To tell the truth, the ordinary complication of the method is here transferred to the apparatus, and outside a standardizing laboratory it impresses us as a device to be used with extreme caution. We should much like to see the results of a test of fifty lamps or so first measured by any of the usual methods and then by the use of this integrating photometer in the hands of a careful man, not previously familiar with its use. For such an apparatus to realize anything like its full value in the art, it must be such that it can be worked with rapidity and precision in the hands of any man capable of good work on an ordinary photometer, and when used at infrequent intervals. If the mirror adjustments have to be frequently altered and are likely to be easily affected by the conditions of ordinary use and disuse, so that an elaborate overhauling is necessary whenever a fresh lot of lamps has to be tested, the general usefulness of the device will be greatly reduced. Our mind is no means clear on this point, and the paper is not over and above reassuring in its description of the adjustments to be made. However, time and experience will answer for this matter, and we trust that the new apparatus, which is based on scientific principles and is highly ingenious, will come through the tests in a satisfactory manner. But unless it is of so reliable a character that one can walk into his photometer room take the cover off the integrator, get out his standards, turn on the current and get to work sampling lamps in a very short time, it will fail of doing

the thing for which it is most needed. If it proves reliable and simple of application, we hope it will form the basis of a general commercial application of the mean spherical candle-power criterion in the rating of incandescent lamps. Such a rating should have been applied long ere this, and would have been save for the trouble involved in making the measurements as a commercial operation. Once applied it would treat with grim justice filaments of every section and shape.

Mr. Burnett's paper is of more theoretical than practical interest, but it does admirable work in pointing out some urgent problems which the advance in the art has brought forward for solution. In particular the author dwells on the need of better and more facile means for measuring illumination at any desired point instead of determining it in terms of a luminous intensity and a dubious coefficient of diffusion. The instruments he suggests ought to be useful in many instances, as in fact any portable and compact form of daylight photometer is bound to be. A trained observer can even do capital work with a standard candle in one hand and a Bunsen screen in the other. After all, however, it must be admitted that even if illumination could be accurately measured at any given point, it would still fail of defining the quantity which is really significant. One must never for a moment forget the physiological factor in illumination, and if the only specification were a demand for a certain minimum number of luces or a certain average number thereof, one would still have the possibility of very good or very bad results. The eye automatically steps itself down in the presence of a bright light, and hence the intrinsic brightness of the radiant must never be forgotten. The "visual usefulness" of illumination depends not only on the luces available at a given point, but inversely upon the brilliancy of the source from which the luminous flux proceeds. It makes a deal of difference whether the eye in the presence of this illumination is able to work at f 5 or at f 20, and this difference depends not on volition but upon the intrinsic brilliancy of the source. Hence, every instrument which works with a shielded eye is at a serious disadvantage in fixing the real working value of the illumination. This phase of the matter has as yet been very little investigated, and in interior illumination at least it is of the first order of importance. However, every bit of work on practical illumination is a real help, and the more lines of experiment opened the better. The paper by Dr. Sharp serves an excellent end by showing that with intelligent care photometric measurements can be made with an accuracy entirely sufficient for any commercial purpose.

RELATIVE RATING OF ENGINES AND GENERATORS.

The relative capacity of a generator and its engine has always been a fruitful topic for discussion, but generally with relation to the point of maximum efficiency. Thus, in railway and variable-load work especially, it has been maintained that the engine should be of somewhat larger rating than the generator, for the reason that the latter will bear a temporary overload and the engine will not. The general practice, however, has been to provide that the most economical load for the engine shall coincide with the rated maximum load of the generator, and to care for temporary overloads by increasing the point of cut-off of the engine, enabling the generators to be greatly overloaded without slowing down the engine. On the other hand, the proposition has been advanced that the engine should be made sufficiently small that in case of heavy overload due to short-circuit, it will slow down. While this idea has not been accepted in practice, it is by no means certain that it is not worth considering in some cases.

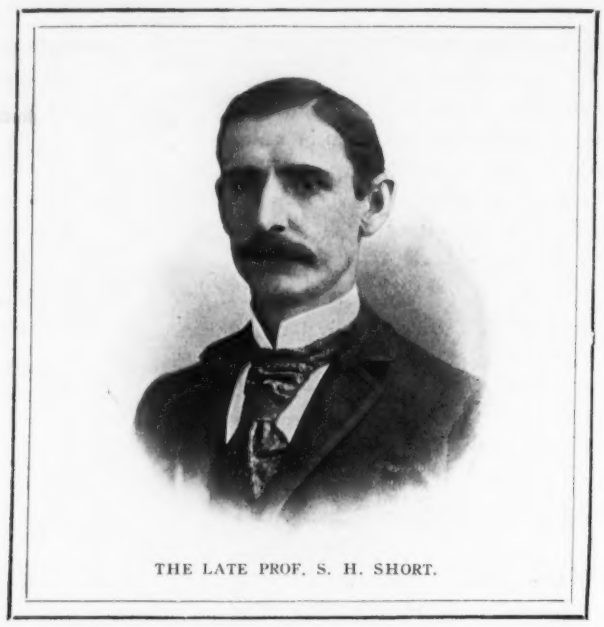
Practically, in the majority of cases it would not be advisable in applying this plan to reduce the size of engine units below what they are now proportionately to the units they drive. The main consideration is so to limit the point of maximum cut-off of the engine that it will slow down in case of a heavy overload on the generator. In other words, the engine would in such a case be put on practically the same basis as a water wheel, which exerts its maximum torque at rated full load; consequently, a station thus equipped with engines and generating units would behave very much like a water-power station. It might be said that a slowing down of the generators in case of an overload of this kind would throw them out of step with synchronous motors and converters in circuit, and that it would be better to have them hold up their speed under overload to the point where the automatic circuit opening device would act. In this connection something can be learned from the practice of many water-power plants operating long-distance transmission lines in the far west. In some of these plants, where much depends on the continuity of supply, fuses and automatic circuit-breaking devices of all kinds have in many cases been discarded, except at the distributing end. This is true of many of the more important plants, and others which have not adopted this practice are operating very much under their maximum load or have circuit-breakers or fuses which will stand so much more than the ordinary load before acting that there is practically no danger of their opening accidentally. Where generators and transmission lines are operating without any automatic circuit-opening devices, it might be thought that there would be great danger, in case of a short-circuit on the line, of damage to the generator by overload before the attendants could open the circuit. But it is held that this is in favor of a system in which the prime mover will slow down in case of overload. In the event of a continued short-circuit on a transmission line from a water-power station, the wheels driving the generators immediately slow down and the lower voltage limits the current which can flow through the short circuit to a comparatively small amount for a short time. Further than this, the generators used on this work usually have sufficiently high armature reaction to prevent an excessive current upon short-circuit.

The claim of interest for this practice is that it involves more reliable and continuous operation than can be secured if the speed were held up under a short-circuit with automatic circuit breakers or fuses to protect the generators, which fuses or circuit breakers while accomplishing the object of protecting the generators, are liable to open unexpectedly at times of heavy load and so interfere seriously with the service. There is also the difficulty of opening such short-circuits without risk of injury to the high-tension, circuit-breaking apparatus. Short-circuits on a long-distance, high-voltage, transmission line are almost sure to occur at some time, and in the absence of fuses or circuit breakers, it is often the case that they will be burned off immediately, so that the service will not be seriously interfered with. If, on the other hand, they are not immediately burned off, the switchboard attendants can open the low-tension switches, which will allow the arc between the high-tension wires to go out; then upon reclosing the switches the service is at once continued without the delay incident to closing a lot of automatic devices. It is claimed that this can sometimes be done so quickly that motors and other apparatus on the line may be kept in service without stopping. In any event, the time required to get over any trouble caused by short-circuit is less than if fuses and circuit breakers are to be replaced after a general opening of all these devices. It is admitted that there are places where the practice of running without these safety devices would not be advisable, because of the great amount of power involved, but it is maintained that there are many places where it should seriously be considered when designing an engine-driven plant; and that in the case of direct-current apparatus the argument in favor of the system has even more force, because the armature reaction tending to reduce the current on short-circuit is less than in the case of alternators.

Sudden Death of Prof. Sidney H. Short.

Word reached this country last week, by cable to the daily press, of the sudden death of Prof. Sidney H. Short, the well-known electrical inventor and street railway engineer, and technical director for the leading English firm of Dick, Kerr & Co. It appears that Prof. Short was about to proceed to this country on a trip, but was taken ill and was treated for appendicitis, dying under the operation.

Prof. Short was born in Columbus, Ohio, in 1857, and was, therefore, only 45 years old. He graduated from the Ohio State University in 1880. While in college he invented and patented a long-distance telephone transmitter and an improved arc lamp. He was appointed professor of physics and chemistry in Denver University, and while in that city built, in 1885, his first electric railway, which was a conduit line. It was illustrated and described in these pages. It operated on the series system. The first car was called the "Joseph Henry." In 1887 he returned to Columbus and built a 2½-mile electric railway in that city. He built another line in St. Louis in 1888, and in 1899 removed to Cleveland, where he organized the Short Electric Railway Company, which soon took a prominent place as a manufacturer of electric railway apparatus. After the absorption of this company by the General Electric Company, a proposition was made to him to engage in his chosen field by the Walker Manufacturing Company, which up to that time had been a large manufacturer of cable machinery. He became its vice-president and electrical engineer,



THE LATE PROF. S. H. SHORT.

Walker motors and generators were soon placed upon the market, and achieved a high reputation for excellence of design and construction. While connected with this company Professor Short paid special attention to the problems of heavy electric railroading, and developed an 80-hp motor for electric railway work, which was adopted on the Brooklyn Elevated Railway, and a 150-hp motor, which was put in service on the Metropolitan West Side Elevated Railway, of Chicago. He also developed a pneumatic system of multiple-unit control.

In 1898 the control of the Walker Company was absorbed by the Westinghouse interests, and early in 1899 Professor Short sailed for London, becoming technical director of the English Electric Manufacturing Company, a corporation organized by British capitalists, under the leadership of Dick, Kerr & Co. Very large works were erected by the concern, at Preston, England, and the work of manufacture was commenced. The success of the enterprise was immediate from the start, and orders were received not only from many of the large tramway companies in Great Britain, but also from British colonies in the East and from a number of continental countries. Professor Short's record in England as an electrical inventor and manufacturer was not below that made by him in America. In spite of his residence abroad, he never gave up his American citizenship, and with his wife made several trips to this country, the last one being on the occasion of the convention of the American Street Railway Association in New York, in 1901, where he renewed his acquaintance with many of his former friends.

Prof. Short was an extremely agreeable companion, and had a very wide circle of friends. He leaves a wife, three sons and one daughter. His eldest son is now taking the engineering course at Cornell University. The deceased was a member of the American Institute of Electrical Engineers, and was an active contributor to the transactions of engineering societies and to the columns of the technical press.

Submarine Boat Tests.

It is announced from Washington that much interest is displayed by the officers of the navy in the coming official tests of the new Holland electric submarine boats "Moccasin" and "Adder," which will be held this coming month. Peconic Bay, Long Island Sound, probably will be selected as the ground, and the course will be off Shelter Island, where the boats will be tuned up for the occasion. Exceptional care has been taken by the officers in charge to make these tests as comprehensive and as rigorous as is fair to the contractors. The tests will be for endurance, speed ,stability, dirigibility, torpedo discharge and general performance.

Rear Admiral George W. Melville, chief of the Bureau of Steam Engineering, who is the most pronounced opponent of the diving type of submarine boat, has called the attention of officers of the navy to what they may expect, if the tests prove sucessful, and has sounded a note of warning in an article, in which he says:

"If the boat has any military or strategic value we should change our policy of ship construction, for nothing could justify the building of so many battleships if the submarine boats possess even a portion of the advantages that their advocates claim. From the time that the Senate and House naval committees look with favor upon these boats, there will be a decreased construction of battleships, and the action of Congress in striking out of the naval appropriation bill of 1901, all authorization for battleships and cruisers can certainly, in part, be traced to the belief that the submarine possesses many of the qualities claimed by its advocates."

Rear Admiral Hichborn, who was many years chief of the Bureau of Construction, in discussing the subject last week, said: "The smaller countries of the world are greatly interested in the question of submarine torpedo boats. You can easily see what their success means to nations like Portugal, Brazil, Venezuela, Norway, Mexico, Chile and many other countries with seaports which they are anxious to protect, but without the necessary means to either equip a suitable navy or erect and maintain extensive land fortifications. The cost of a modern battleship or armored cruiser of the first class is about $6,000,000. That would construct almost 40 submarine boats, so that for the equivalent of one great fighting machine almost any country in the world, and especially the smaller ones, could secure enough submarine boats to defend its harbors.

"I consider a thorough blockade of a harbor defended by such boats a practical impossibility, for the most intrepid commander would not maintain his fleet in the mouth of a harbor at night exposed to their attacks, but would draw off to sea, thus enabling the defenders to get out or their friends to slip in. The new boats are the first to be constructed under the direct supervision and inspection of officers of the navy and under contract with the United States Government. Many improvements have been made over the Holland in the new boats. I confidently expect them to demonstrate the value of submarine boats and make their construction a permanent part of the naval programme."

Underground Road for Berlin.

A plan has been laid before the Berlin Municipal Council for an underground electric railroad from the extreme north of Berlin to the Hillisches Gates, ending at the suburb of Schoenberg, a distance of seven miles. Four years will be required for the construction of the road, and its cost is estimated at $14,000,000, to be covered by a loan. It is reported that the underground and other municipal undertakings will render a $50,000,000 loan necessary.

Train Wireless Telegraphy for Italy.

It has been decided to establish Marconi wireless telegraphy apparatus at all stations, and on all passenger trains on Italian railroads. King Victor Emmanuel, of his own initiative, has appointed Signor Marconi a Chevalier of the Order of Industrial Merit.

Some Features of the Valtellina Three-Phase Railway.

BY CESARE PIO.

THE Valtellina three-phase railway, which was condemned in advance by those opposed to alternating-current traction, is now regularly operating both a freight and passenger service with the most gratifying success, and the Società della Rete Adriatica, which owns the Valtellina Railway, is contemplating extending the same equipment to the Lecco-Milan branch. The writer is of the opinion that had the line not been handicapped by physical conditions, there would have been no delay in the operation of the road. As it was, the Ganz Company had not only to work out the matter of 3,000 volts at the trolley, but also encountered a number of unusual difficulties, such as a great number of tunnels located along the line, the smoke of the steam trains, which were operated during the whole time of the experiment, etc.

The two branches, Colico-Chiavenna and Colico-Sondrio, have been running since the 4th of September without the slightest hitch, and the running of freight trains and passenger trains seems to be just as simple as in the case of a 500-volt street car. The overhead network itself is not as intricate as that of some ordinary trolley lines. The greater danger involved to motormen handling controllers is avoided, as they cannot touch the live parts of the same until the trolley arch is lowered. All this has been secured through an ingenious system of interlocking devices, which have been worksatisfactorily so far. Only one accident, resulting in the burning of the left arm of a motorman, happened during the whole year of experiments and test. This man, not observing the rules, forced the controller door open, and came in contact with the 3,000-volt connection.

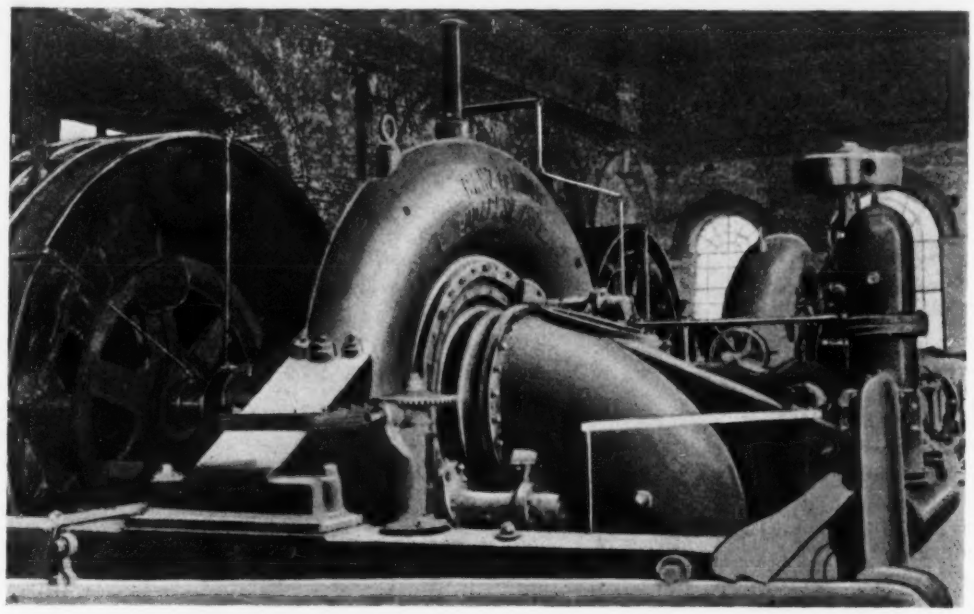


FIG. 1.—ALTERNATOR DIRECT-CONNECTED TO TURBINE.

For the operation of the road, water power from the Adda River was utilized.

The new stone canal and power house at Morbegno (between Colico and Sondrio) are designed to utilize still further the flow of the river. At present 6,000 hp are available. The canal was cut through the rocks of the mountains, and in several places is a tunnel. In the original project of the railway company, the whole canal was designed as a tunnel. The latter would have required more time for the construction, but, on the other hand, it would have been good policy, as the materials constituting the mountain are very soft and apt to fill the canal and interfere with the flowing of water. The water is carried to the head stock at a height of 90 feet above the power station; the amount of water is 25 cubic meters per second, so that the power available at the turbine axle is 7,500 hp, assuming an efficiency of 75 per cent. of the turbines. The turbines are of the Ganz type, direct connected to Schuckert three-phase alternators of the revolving-field type. Their stationary armatures give directly 21,000 volts. The armature coils project outside the cast-iron rings so that fine ventilation is assured. The exciters are mounted on the alternator shaft, and on the same shaft is also fixed a safety device of the centrifugal type, which, in case the turbine should attain a speed above 175 revolutions, inserts a very high resistance in the exciter's field The sets are actually too long for the size of the power station.

A mistake made, perhaps in designing the power station, was that of installing only two steel tubes for the turbine head stock. Each head stock should consist of two tubes, so that in case of accident to one the other will remain in service.

All the electrical equipment of the Morbegno power station was made by the Schuckert Company, including the whole switching work. The switching system includes six panels and a large-sized room on the back of the board. The panels can carry only low-tension apparatus, and the levers by which alternators are switched into parallel. The room at the back contains the high-tension switches, the lightning arresters, the transformers for the instruments and also two sets of bare copper bus-bars. No oil switches are used. The type adopted is the open type of the Schuckert Company, with the addition of copper horns of the well-known type of Siemens & Halske lightning arrester. These switches are located at the height of 12 feet, and are operated by means of ordinary ropes, so that there is no chance of injury to a person.

To American engineers, the large room required by continental high-tension switchboards is striking. In fact, the main difference between American and European practice in this work is that Americans want little room and much installation, and Europeans seem willing to sacrifice economy of the room in the back of the board, owing to the difficulty and expense of getting high insulation in limited space. It is a fact that the absolute absence of oil, rubber, fiber, wood, etc., renders the Morbegno switchwork entirely fireproof, which feature is absent from any American boards filled on the back with all kinds of insulating stuff. The main transmission line consists of only three wires, which is regretable, as in case of accident there is no reserve line.

Naturally, the main difficulties were encountered in equipping the overhead network. Besides the ordinary trouble of keeping a high degree of insulation, trouble from the smoke deposited by the locomotives on the insulators was encountered. But where the difficulties met were greatest was in the tunnels. The track had been laid out originally for slow steam trains, and with the increased speed of electric trains, it was necessary to add to the inclination of the roadbed to compensate for the effects of the greater centrifugal force. The new inclination of the roadbed caused the trolley arches to touch the walls of the tunnel at places, especially in the curves. This inconvenience has been obviated by changes of the trolley line and substituting a longitudinal suspension for the transverse suspension of the trolley wires. The transverse suspension proved too rigid, the trolley arches often jumping off and breaking when passing under the suspension points. The last branch of Lecco Colico is now ready for operation, it not having been started September 4, owing to lack of trained motormen.

The transformer substations are located along the line, and contain Ganz transformers of 450-kw, a motor for running the ventilators for cooling the transformers, a lightning arrester and switching apparatus of the above-mentioned type.

The poles supporting the trolley wires are of wood, which indicates that originally the line was intended as a simple experiment. In five years these poles have to be replaced by iron or steel poles. The poles carry also the primary line. The suspension of the trolley wire is made without soldering, and it may be noted that there is not much complication of wires. Two peculiar features of the line are the double insulation and the elastic suspension of the trolley wires. Where the primary line crosses the trolley wires, a special arrangement has been devised to avoid accidents, being such that in case of a communication between a primary and secondary circuit, the fuses blow in the secondary substation. The cars are well equipped, and were entirely built at the Ganz works. Lately, there has been added to the trolley arch a little dash pot, so that in lifting up and lowering down with compressed air, inconveniences due to

the kinetic force are avoided. A cooling device has also been added to the water resistances of the controlling apparatus.

Worthy of special attention and study is the collecting device of the trolley. It consists of two cylindrical rollers terminating in two little conical surfaces, designed to work especially in the switching points. The rollers are of phosphor bronze, and are fitted with ball bearings of a diameter somewhat larger than is used for ordinary bicycle bearings. It is important to note that these bearings do not carry current at all. The current is conveyed by means

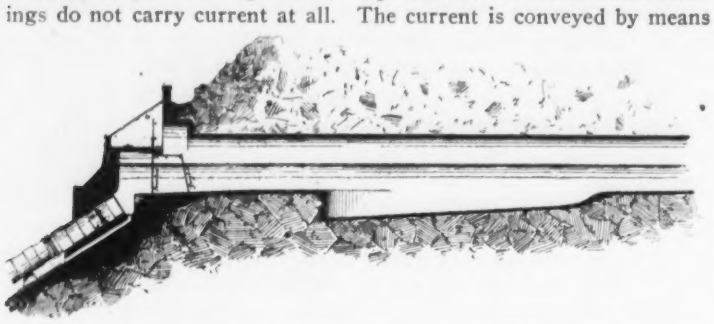


FIG. 2.—LONGITUDINAL SECTION OF TUNNEL AND DRAFT TUBE.

of small carbon contacts. The two rollers are insulated from each other with wood.

The locomotives for freight service have a tractive effort of 10,000 lbs., and run at the speed of 18 miles per hour. The motor cars run at two different speeds, 18 and 36 miles per hour.

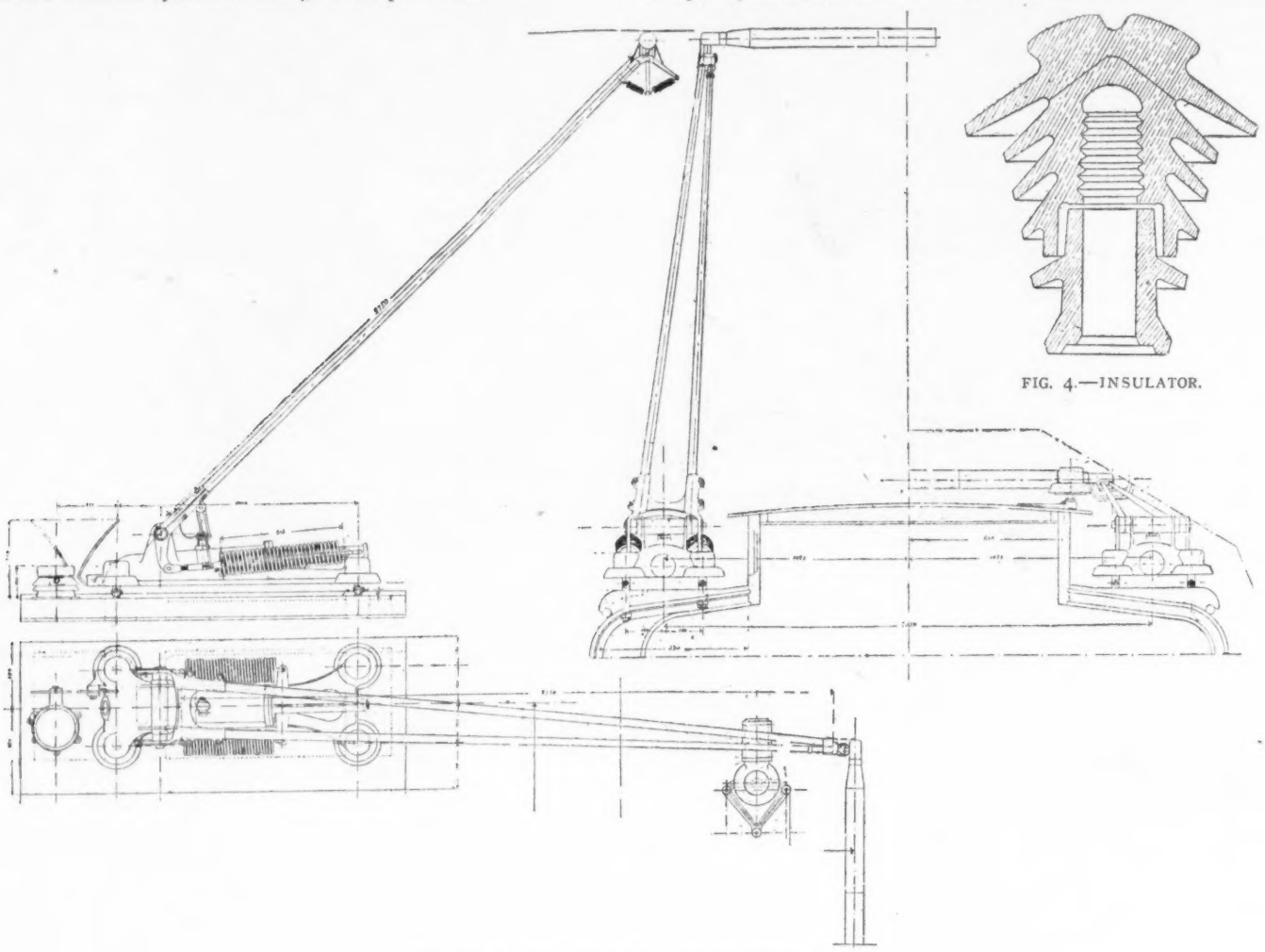


FIG. 3.—ELEVATIONS AND PLAN OF TROLLEY.

FIG. 4.—INSULATOR.

In the motorman's cab the following apparatus are installed: An automatic circuit breaker for the primary current, with the necessary fuses and the reversing device; a controller for starting and changing the speed; a valve for the compressed air, working the Westinghouse brake, and for lifting or lowering the trolley; a switch for the compressor motor; a voltmeter; an ammeter, and an air gauge. The cars are electrically lighted, heated and ventilated with current at 120 volts, derived from a small step-down transformer installed in the car. At present the Ganz Company is lighting all the railway stations of the line by utilizing primary current from Morbegno, after lowering its voltage with convenient transformers. Tests were made with 15 cycles, but they gave bad results, the flickering of the lamps being too noticeable.

Now that the work is finished, great honor is due to the Rete Adriatica for its bold initiative in the enterprise, and to the skill of the Ganz Company for the excellent solution of difficulties offered in a problem which could have resulted in a loss of 6,000,000 francs in case of failure. On the other hand, the Italian government, instead of encouraging and facilitating an enterprise destined to so greatly extend electric traction in Italy, put all manner of difficulties and trouble in the way, which indicates how unfortunate the situation would be should the government take over, as has been proposed, all Italian railways.

Wireless Telegraphy in War.

A dispatch from London says: At the naval manœuvres in the Mediterranean, the Channel and Mediterranean squadrons comprised the largest fighting force ever concentrated in one sea. The most interesting feature was the blockade of a collection of battleships, cruisers and torpedo craft in the Gulf of Argostoli by two forces more than twice its strength. The blockaded fleet, which was commanded by Prince Louis of Battenburg, made its escape without molestation, to the surprise of everybody. A correspondent who witnessed the manœuvres writes that the wireless telegraph system broke down completely in the face of the enemy, who deliberately and continuously sent confusing messages. In its present state it is absolutely useless for war purposes.

Work in the Philippines.

The Philippine commission has passed a bill providing for the construction, at Manila, of a standard-gauge electric railway. Maps and specifications will be exhibited in Manila and in Washington at the Bureau of Insular Affairs. The bids will be opened at Manila on March 5.

20,000-Volt Three-Phase Plant in France.

BY P. LETHEULE.

HIGH-VOLTAGE transmissions are rare in France and though many projects have been proposed, they will probably await the commercial success of the plant forming the subject of this article. This plant is situated in the Department of Aude, in the extreme southeast of France, of which Carcassonne and Narbonne are the principal cities. The generating station is situated in the Corbières, at the mouth of Saint Georges, near Quillan. The total head of water is about 330 feet. The dam is in the river Aude, about 35 miles from its source in the mountains.

The dam at Saint Georges is a solid masonry structure. A canal having a total length of 18,000 feet extends underground for some 13,000 feet, and is open for the remaining 5,000 feet. The open portion is built of cement supported by wood in a very similar manner to the construction used for the Simplon tunnel generating station. The size of the underground part of the conduit is 6½ x 6½ feet. The incline is 7 feet per mile. In the open part of the canal this incline is increased to 10 feet, and the section reduced proportionately.

The canal brings water to a forebay from which lead two iron conduits of 3 feet 3 inches diameter to the generating station. These conduits are supported every 10 feet of their length by masonry, on which they can slide, and an expansion joint is provided every 650 feet. In a length of 650 feet the loss of head is 3½ feet.

The generating station is built over the iron conduits bringing the water to the turbines, and consists of a rectangular building of one floor, sufficient for eight groups of machinery, of which four are now installed and in service. At the end of the building is erected a platform, supporting the low-tension and transformer panels. In an extension of the building at the back is erected a high-tension switchboard and transformer room.

The generators deliver three-phase alternating current, at 2,900 volts, 50 cycles, to the low-tension panels in the generating room, and thence to the secondary low-tension side of the step-up transformers, the high-tension side of which delivers 20,000 volts.

The turbines are rated at 800 hp at 300 r. p. m. The wheels are of the Pelton type and were built by the Ateliers de Construction de Vevey. They are regulated either by hand or by an automatic regulator of the mechanical type. The distributor to the turbine offers four openings, which can be more or less regulated by a cylindrical valve controlled either by hand or by an automatic hydraulic regulator. The hydraulic regulator uses water under pressure from the conduits, which is previously cleaned by being passed through a filter. This regulator works perfectly, a sudden difference in load of 50 per cent., not affecting the speed above 4 per cent., and 100 per cent. variation, affecting the speed less than 10 per cent. It might be feared that the sudden difference in pressure would be dangerous to the conduits or the connections, but a regulator has been installed for preventing such a disastrous effect; it simply opens an outlet valve and discharges the water in case the pressure gets too high. The conduits conducting the water under pressure are also protected by tubes connecting with the open air at some distance above the station.

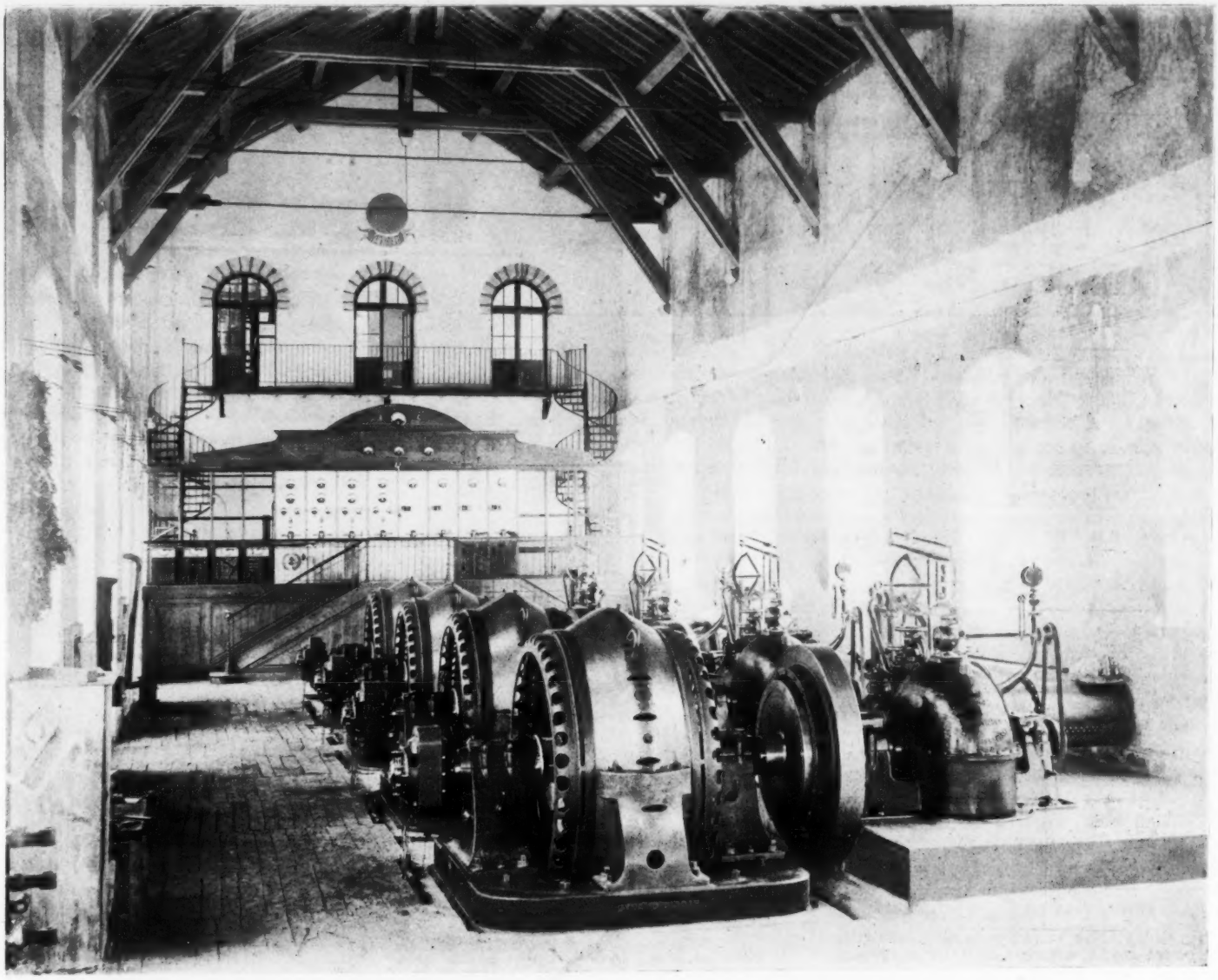


FIG. 1.—INTERIOR OF GENERATING STATION.

The efficiency of the turbines reaches 77 per cent. at full load. Their axis is 11½ feet above the level of the water on the lower side, but the corresponding power is not entirely lost, an exhaust tube being designed for admitting air and water, giving a kind of relative vacuum, and allowing a certain amount of the power to be regained.

The generators are Alioth three-phase machines. Their rating

is 700 kw for a power factor of 100 per cent. or 540 kw for an 80 per cent. power factor. They operate at 50 cycles and 300 r. p. m., and generate 2,900 volts. The revolving part is entirely of iron with no windings. The fixed windings are star connected. The exciter is run on the end of the shaft, as in most German and Swiss installations. The exciting voltage is 50 to 60 volts, and the exciting current 25 amperes for full load, which gives .25 per cent. excitation loss. The efficiency at full load is 93 per cent. The drop in voltage is 5 per cent. for non-inductive load, and 16 per cent. for inductive load, 80 per cent. power factor. The weight of each machine is 35 tons, 12 tons of which are accounted for by the revolving part.

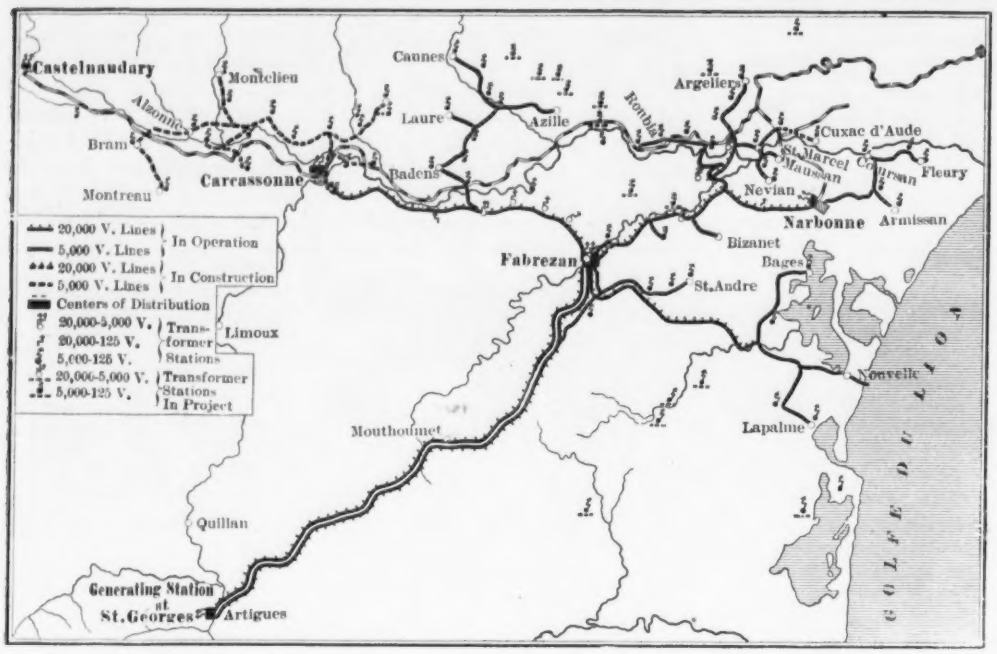


FIG. 2.—MAP OF TRANSMISSION SYSTEM.

The cables from the machine to the low-tension switchboard in the gallery are provided with silver fuses. These cables are supported on porcelain insulators, and are provided with highly insulated connections.

The connections of the generating panels allow the machine to be run in parallel on one set of bus-bars, to which the low-tension secondaries of the step-up transformers can be connected. The voltage regulation of the alternators running in parallel is by hand, the field rheostats being mechanically coupled together and controlled by one single handle.

The high-tension step-up transformers which are between the high and low-tension switchboards consist of single-phase transformers, star-connected in the way well-known in the United States, but which is quite exceptional with continental constructors. In spite of the high voltage, the transformers are not cooled with water or oil; the windings are simply exposed to the air, though it is proposed to employ mechanical air ventilation if necessary.

The high-tension side of the transformers is controlled by switches placed on the high-tension switchboard, above the transformer room. The peculiar feature of these is the pneumatic or compressed air control from a distance, enabling the circuit to be opened or closed from the generating room by a man at the low-tension switchboard. There is a compressed air reservoir giving 90 lbs. pressure per square inch, which compressor is run by a low-voltage, three-phase induction motor.

Reference to the accompanying map will show the extent of distributing network, which seems at first sight disproportionate to the amount of power distributed, which is only some 1,600 kw, though intended in the near future to reach a total of 3,600 kw. This is far from being a great amount of power, but France is not a country possessed of great sources of hydraulic power as are the United States and a few countries in Europe, such as Switzerland, Sweden or even Italy and Germany.

The total length of lines reaches 240 miles, and will be extended to 360 miles. The distance from generating station to distributing center is 42 miles, and the main high-tension feeders distributing power from this center to the main transformer stations are from 18 to 24 miles long, so that the total distance from the central station to distributing points attains about 80 miles.

Three-phase transmission was selected, the choice being due to the power being required for public and private lighting and for small and large motors in many branches of industry. The long distance and the unusually large numbers of centers of distribution led to the adoption of alternating current, due to its great facility of transformation to various voltages. The presence of motors on the network of lines led to the use of polyphase current, the simplest and best form of which was deemed to be three-phase. The use of current for lighting led to the adoption of a frequency of 50 cycles.

All the hydraulic plant was designed and built for an output of 3,600 kw, but as only half this power was contemplated at first, the electrical plant is laid down for the latter output, further units to be added as required. Although this output is not very considerable, the tension of the line is quite high, 20,000 volts having been chosen. This pressure is not too high, as will be seen from the calculations given further, the diameter of the copper wire being 7.5 mm. The promoters, however, considered it advisable that the pressure should not be increased beyond 20,000 volts, by reason of the large number of small transformers and motors utilizing the power along the whole extent of the line, and also of the greater expense and difficulty of maintenance and inspection. A few special transformers have lately been installed, at the request of customers, for a power output as low as 3,500 watts, the construction of which for 20,000 volts entails special care and high cost. The low-tension

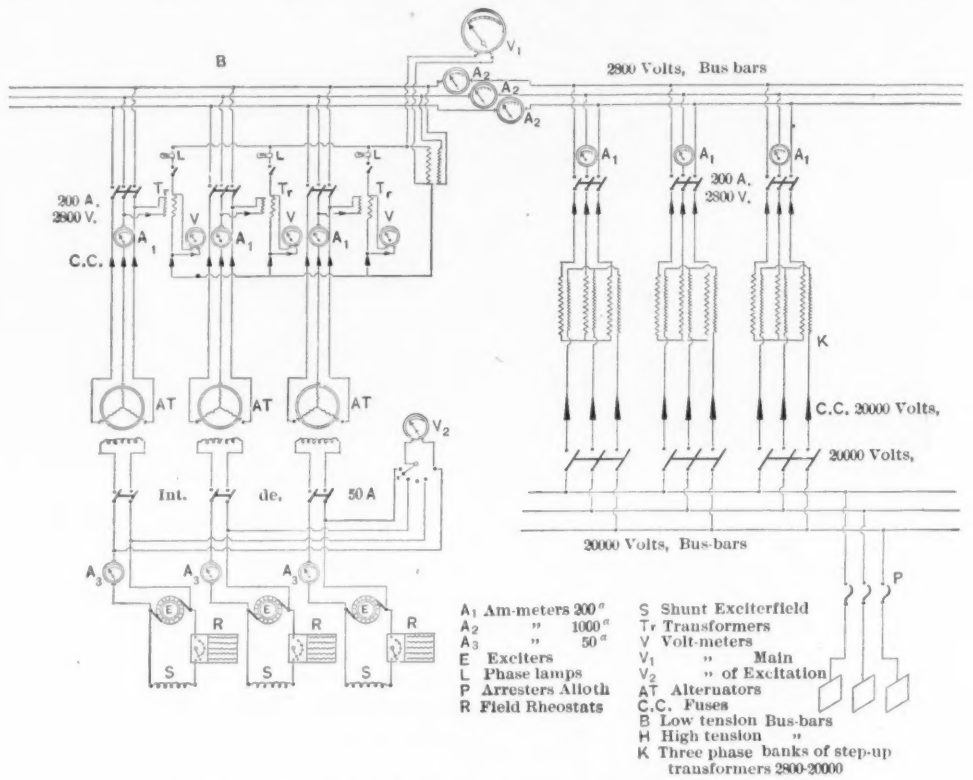


FIG. 3.—DIAGRAM OF CONNECTIONS OF HIGH AND LOW-TENSION LINES.

winding is placed directly on the core and inside a porcelain sleeve with large projecting ribs, around which the 20,000-volt primary is wound.

High tension is not used for the whole of the distributing lines running to the numerous small towns and villages where light and power is distributed. The voltage used here is 150 to 300 volts; an intermediate voltage of 5,000 is also used, stepping down to 125 volts for local distribution.

The 5,000-volt distribution has no special interest, but the 20,000-volt transmission line deserves more than passing notice.

The 20,000-volt transmission line of 80 miles is divided into sections. The first 42 miles of line running from the generating station to the main distributing center has been calculated for a loss of 20 per cent. in the transmission of 1,620-kw inductive load at 80 per cent. power factor. The resistance is determined from the following formula:

$$324{,}000 = 3RI^2,$$

R being the resistance of the cable, and I the current. The current amounts to 54 amperes, and thus the resistance of one conductor is 36.06 ohms; allowing for impurity of copper and a temperature of 15° C., the section adopted was 38 mm²; that is, a diameter of 7.5 millimeters for the conductor.

The drop in volts due to resistance is represented by the formula, $E' = \sqrt{(E - RI\sqrt{3})^2 + (RI\sqrt{3}\,tg\phi)^2}$. From this we find the drop to be 3,240 volts, and the volts at the generating station 20,240. It follows from the above that the weight of the copper reaches 75 tons, in spite of the high percentage of loss in the feeder.

The voltage at the central distributing point is in consequence regulated between 17,000 and 17,200 volts, according to indications received at the generating station from the receiving or distributing point. The stations are connected by telephone, and it has become quite feasible through experience acquired to regulate the voltage at the generating station by watching the total-output ammeter.

As to impedance, the distance between wires being 2 feet, we arrive by Blondel's formula, subtracting the mutual inductance from self-

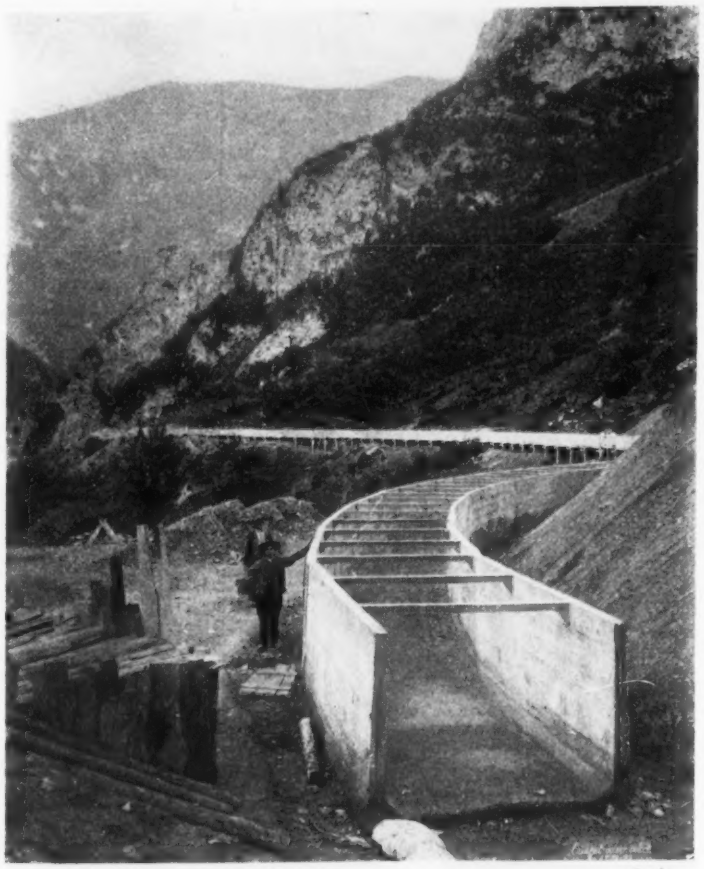


FIG. 4.—ARMORED CEMENT WATER CONDUIT.

inductance of the two wires, at a value of inductance of 1.7 millihenrys per mile; so that the resistance factor, which is the ratio of reactance to ohmic resistance, is about 0.641 for the frequency of 50 cycles. This inductance increases the drop in volts by $\sqrt{1 + 2(p\text{-}p^2)(cos\,\phi + msin\,\phi - 1) + p^2 m^2}$, p representing the relative loss of tension and m the reactance factor. Three per cent. has, therefore, to be added to the voltage of the generating station, to compensate for this impedance drop.

The effect of capacity can be approximated by assuming a condenser placed at a certain point in the line, the charging current of which will be about 4.6 amperes at 20,000 volts. Experience does

FIG. 5.—POWER HOUSE AND DRAFT TUBES.

not check these figures, as the ammeter shows 10.2 amperes as charging current with a tension of 17,600 volts at the generating station at no load. This changing current is equivalent to about 300 apparent kw-amperes; that is, half the rating of one generator. The current, however, leads so much that it is sufficient to allow 6 amperes exciting current to obtain the normal voltage at the terminals of the machine, instead of 12 amperes required when running. Experience has verified that the charging current is proportional to the pressure and to the frequency. It has been remarked also that the generating station voltage being 17,600 volts for no-load on the line, the rise due to capacity reaching 700 volts, the voltage at the end of the 42-mile feeder amounts to 18,300 volts.

There are three branch lines running from the main distributing center to the three main distributing stations; by adding one of these lines to the length of the main feeder, thereby increasing the length from 42 to 60 miles, we decrease the charging current from 72 to 38 amperes. By including another 25-mile branch line from the distributing point, no modification of this figure is obtained.

The following table gives the value of charge current obtained when the line was tapped at different successive points along its length, as mentioned on the top of the columns:

	St. Louis.	*Talairan.*	*Babrezan.*	*Ornaison.*	*Narbonne.*
Length in miles.....	7	37	42	50	60
Charging current.....	0	68	72	52	38

These results can be deduced from theoretical calculations though the exact laws of distributed capacity are rather complex. Moreover, the capacity has proved to be of no importance under load, and even with the sudden interruption, due to the blowing of a fuse, the rise in tension has never been dangerous. The maximum observed has been 32,000 volts. No resonance effects have been experienced, in spite of the presence of a third harmonic of a very considerable relative value in the curve of the alternators.

The feeder is made of three cables of 38 mm.², separated at a distance of 2 feet. They are supported by wooden poles, 32 feet high, placed 130 feet apart. The poles were treated by soaking them in kerosene. The insulators are of French design, and are provided with triple petticoats, as shown in Fig. 7. The insulators used have been tested to 40,000 volts. The defective insulators could easily be detected at night, owing to certain luminous effects which were never shown by good insulators.

The insulators have worked satisfactorily, and only a few defective insulators have had to be replaced. They have been covered with snow which reached to the tops of the poles, but no accident has arisen. Galvanometer readings showed an insulation of 500,000 volts between the three conductors and the ground. Rainy or overcast weather reduces this to 100,000 volts.

A telephone line is supported by the same poles, 7 feet below the power line. The telephone lines are crossed every 10 poles, so as to compensate for effects of inductance. The working of the telephone is satisfactory as long as the insulation of the line is good, the inductive effects being negligible.

The chief engineer of the line supervises the line and has three assistants under his charge. The first 42 miles of the line is inspected by seven men, under the supervision of the chief of the line, and the branch lines of 20,000 volts are similarly inspected. Short-circuits have been occasioned by trees and by various birds. In case of a short circuit, the tension rises as high as 35,000 volts, but the lightning arresters always protect the line in these cases.

Though the low-tension lines present no special interest, the transformer stations are worthy of notice. The main transformer station is situated in the center of distribution, Fabrezan, from which all tensions are regulated. All transformer stations stepping down from 20,000 to 5,000 volts are protected at the entrance of the line by lightning arresters of the "horn" type, with resistance and inductive coils.

The switchboard is entirely made of iron, and only the low-tension panels at the generating station are composed in any part of marble. The instruments, ammeters, voltmeters, etc., are insulated from the iron switchboard by means of porcelain insulators. The connections are all made of copper, non-insulated, and supported by insulators identical to those used on the line.

The three branch lines running from the central distributing point gives rise to a supplementary loss of power of about 5 per cent. They feed a certain number of distributing points along their course, and are mostly designed for feeding three terminal points at which the tension is stepped-down from 17,000 to 5,500 volts, fed into the secondary network. These distributing points use transformers of 100 kw, protected by lightning arresters of the "horn" type.

The up-keep of the secondary network is much less difficult than that of the primary lines. A great number of secondary posts are distributed on the system, stepping-down the voltage from 5,000 to 125 volts, for supplying motors and lamps.

Motors constitute about half the load of the station. Most of these are small induction motors, wound for 250 volts, with self-contained resistances. They are started by means of the resistances, which are cut out by a bronze contact operated by means of a rod inside the shaft of the motor. Some induction motors, however, have to be started under considerable load, and their starting resistances attain large dimensions; they, therefore, constitute a separate part distinct from the motor, and their final short-circuiting is by means of carbon brushes with rings mounted on the motor shaft.

Some of the motors, it is to be remarked, have an arrangement for automatically bringing into circuit the starting resistance of the induction motors in case of sudden interruption, and thus avoiding the restarting of these motors without resistance.

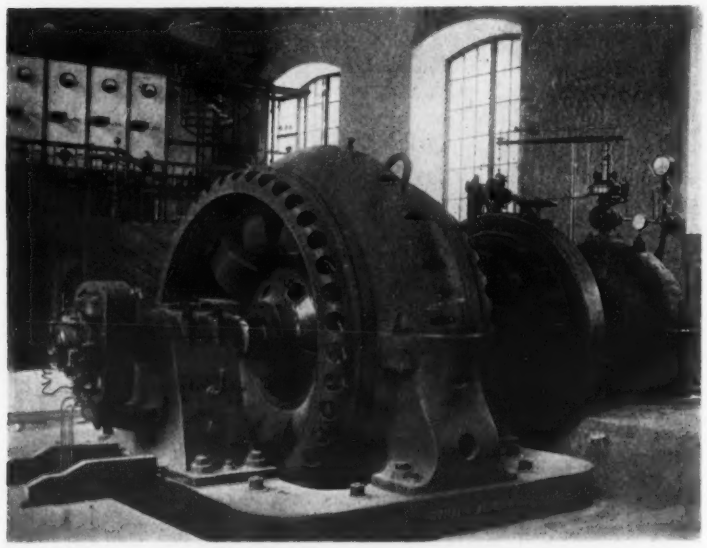


FIG. 6.—ALTERNATORS AT GENERATING STATION.

Only two synchronous motors have up to now been in operation, one at Carcassonne and another at Narbonne, for distributing direct current to the old Edison systems of these cities. These motors, which are rated at 150 kw each, are direct-coupled to dynamos running at 430 r. p. m. The motors are wound for 500 volts, and are fed from the secondaries of transformers of 200 kw each.

The motors are started from the direct-current side, and it has been observed that the synchronization of the first group causes a rise of voltage as high as 25,000 volts, with no load on the line. When the motor is put on the line previously loaded, no difference in voltage can be observed.

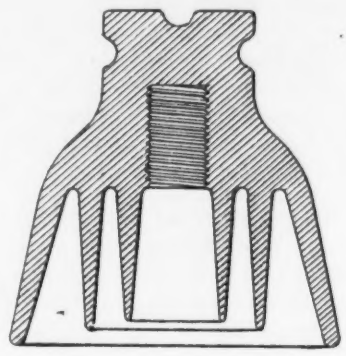


FIG. 7.—LINE INSULATOR.

In case of short-circuits on the line, the motors sometimes drop out of step, and the switchboard attendant then generally lightens the load by decreasing the excitation of the continuous-current generators. It often happens that when the short-circuit ceases, the motor can be loaded again, thus avoiding the dropping out of step of the group. Synchronous motors are used in these two stations, because it was intended to employ them to regulate by raising the voltage of the line by over-excitation, but up to the present this has not been done.

The price for current has not yet been rendered definite. Municipal lighting is granted free of charge to the Communes in exchange for certain rights secured by the company. Every 1,000 inhabitants are entitled to 25 16-cp lamps. Domestic lighting is by contract.

Interurban Work on the Oley Valley Railway.

The Oley Valley Railway may be considered as typical of the interurban electric roads now being built in many localities throughout the country. This road, running out from Reading Pa., is one of the lines owned by the United Power and Transportation Company. The power house at Reading contains a variety of generating apparatus which has been installed at various times to meet the growing demand of the city for power. The power for the electric road is furnished by two 400-kw and one 800-kw generator, direct connected to vertical engines, furnishing direct current at 550 volts.

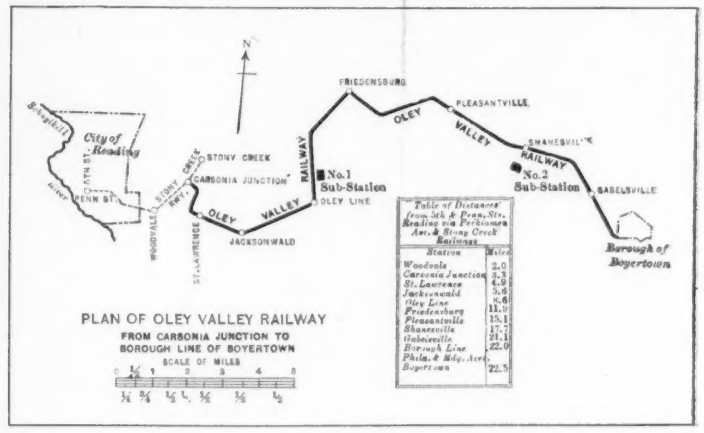


FIG. 1.—MAP OF OLEY VALLEY RAILWAY.

The cars of the Oley Valley road operate over one of the city lines for 3¾ miles, as far as Carsonia Park. This section is supplied with current by a 500,000 circ. mil copper feeder, running direct from the 550-volt bus-bars. The trolley wires are broken at this point, and the remaining 18¾ miles of the road are operated by the sub-

station system. However, there is an independent 4/0 feeder running from the 550-volt bus-bars, extending the entire length of the

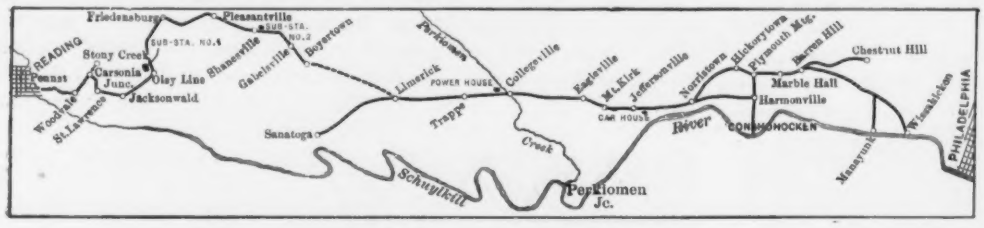


FIG. 2.—ROUTE OF ELECTRIC RAILWAY SYSTEM BETWEEN PHILADELPHIA AND READING.

line. This feeder furnishes current for starting the rotaries, and, in case of accident to the alternating-current transmission, the whole road can be operated from the main power house.

In the Reading power house are two 400-kw rotaries, running inverted. The current from the positive bus-bar passes successively

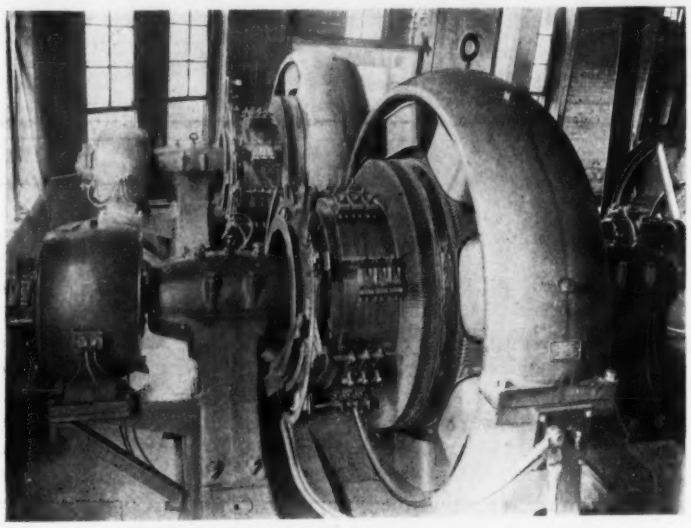


FIG. 3.—ROTARY CONVERTER SUPPLYING ALTERNATING CURRENT, READING STATION.

through circuit breaker, ammeter, starting rheostat and main switch to the commutator of the rotary, returning through a negative switch mounted on a separate equalizer stand to the negative bus-

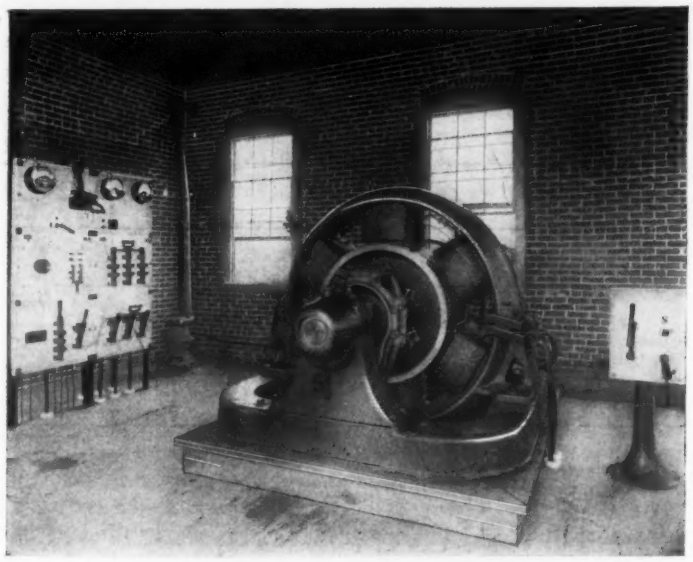


FIG. 4.—ROTARY CONVERTER AND SWITCHBOARD.

bar. By this arrangement no negative leads are brought to the rotary switchboard, and the danger of short-circuits on this board is thereby minimized.

Each rotary is separately excited by a small exciter mounted on its main shaft, operating at 120 volts. From the alternating-current side of the rotary the current passes through low-tension switches and instruments mounted on the low-tension board. Leads runs from this panel to three 280-kw oil-filled, water-cooled transformers, which are placed in a separate room. From the high-tension, 16,000-volt side leads run to the high-tension switchboard, which is equipped with compression ball fuses and emergency switches. In the transformer room there is also a bank of lightning arrester and choke coils.

From the power house, the high-tension current is conveyed through one mile of three-phase, lead-covered cable to the outskirts of the town, where there is a junction box containing a second lightning arrester equipment. Beyond this point the transmission line consists of three No. 4 hard-drawn copper wires, supported on porce-

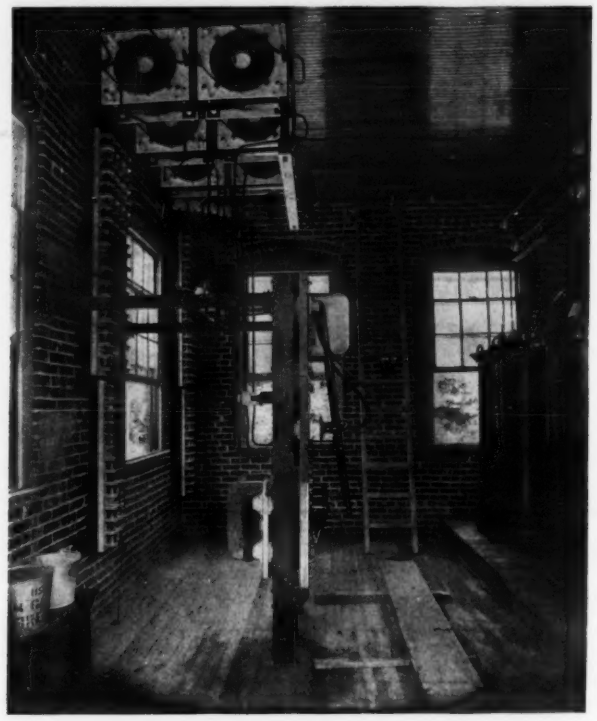


FIG. 5.—TRANSFORMERS IN SUBSTATION.

lain insulators carried on cross-arms upon the same poles as the 550-volt transmission.

The first substation is situated at Oley Line, nine miles from the power house, and the other at Shanesville, 18 miles from the power house. Each station consists of a transformer room and the rotary room proper. In the transformer room are three 100-kw oil-filled, water-cooled transformers, as well as a lightning arrester equipment and a high-tension switchboard. Water is circulated through the transformers by a small pump belted to the rotary, the source of water being a small stream in the vicinity. In the rotary room is a 300-kw rotary converter, with the necessary low-tension switchboard for controlling the rotary and feeding the trolley circuit.

The transformers in the Reading power house are designed for stepping-up to 16,000 volts. The substation transformers are wound for 15,000 volts on the high-tension side, and 300 volts on the low-tension side. As the loss on the line is considerably less than 1,000 volts, the rotary converters therefore supply current to the trolley wires at a voltage slightly above 550. The Stanley Electric Manufacturing Company supplied the rotaries, transformers, lightning arresters, etc., referred to above.

Commercial Telegraphers.

A general convention of representatives of all unions of commercial telegraphers met at Pittsburg on October 26, for the purpose of forming a national telegraphers' union.

The Rowland Rapid Telegraph System—III.

(*Concluded.*)

IT has been attempted, in the preceding description to give only a bare outline of the features of this invention. Much more might be said in regard to the many ingenious devices used and the new mechanical and electrical features employed. The apparatus is, throughout full of beautiful physical principles and most ingenious electrical and mechanical devices. One very important feature of

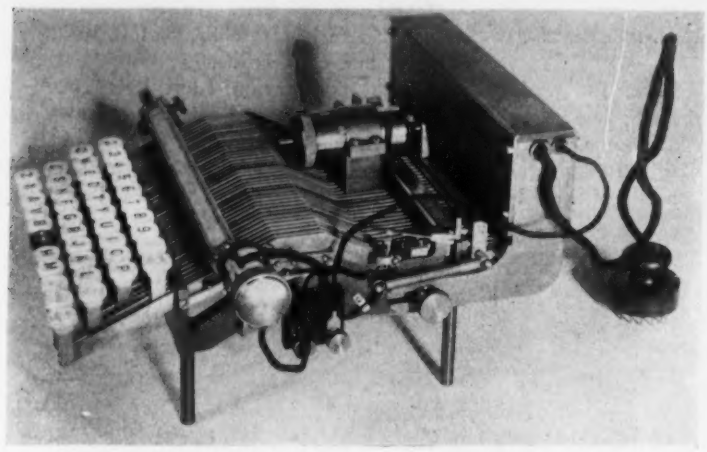


FIG. 9.—KEYBOARD.

the apparatus is the natural way in which it divides itself into distinct units, so that if one unit becomes deranged it may be immediately replaced by another, without stopping the operation of the rest of the apparatus. Thus, considering one end of the line only, there are four keyboards, all exactly alike, which may be replaced singly by others by merely breaking eleven wires joined together by a multiple connector. There are four-page printers which can also be operated, singly or together, and be immediately replaced by others in a like manner with the keyboards. There are four similar banks of eleven polarized relays each. If anything deranges one of these banks, only that printer to which it belongs is affected.

This being the case, it is thought that a clearer idea of the appearance of the apparatus as actually constructed will be obtained by showing a picture of one of each of these units rather than by giving a single view of the entire outfit as installed at one end of the line. Thus, Fig. 9 is a photograph of a keyboard; Fig. 10 shows a page printer; Fig. 11 a synchronizer, the receiving commutator and letter finder. A specimen of the printing is shown in Fig. 13. It will be noted that the operator has spaced and lined and paragraphed the

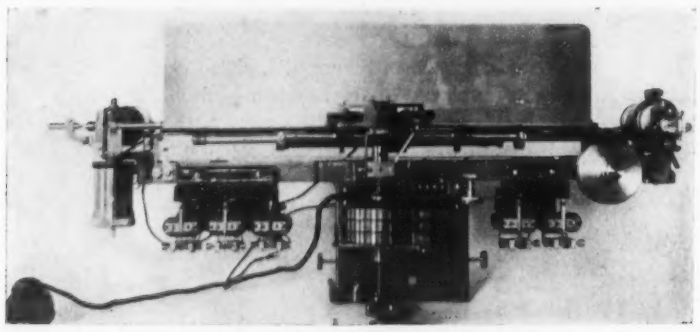


FIG. 10.—PAGE PRINTER.

printing in the same manner as would be done on a Remington typewriter.

LATER IMPROVEMENTS.

The mechanical operation of the page printer has been improved, and the keyboards have been entirely redesigned since the foregoing was written. The main distinction between the old and the new keyboards is that the new keyboard makes combinations electrically. The page printer performs the same functions as the one described, but more perfectly, and functions of minor importance have been added, such as the rapid feeding out of a telegraphic blank, in less than three seconds. The former description assumed that the alternating waves on the line were divided up into five groups: *A, B, C, D, X,* fifty-two waves being used for the purposes of printing with four printers, signalling and finding the letter. Fifty-six waves are now divided into four groups; eleven of the waves in each of the four groups are used for the printing, one wave in one of the groups is used for finding the letter, and three waves, one taken from each

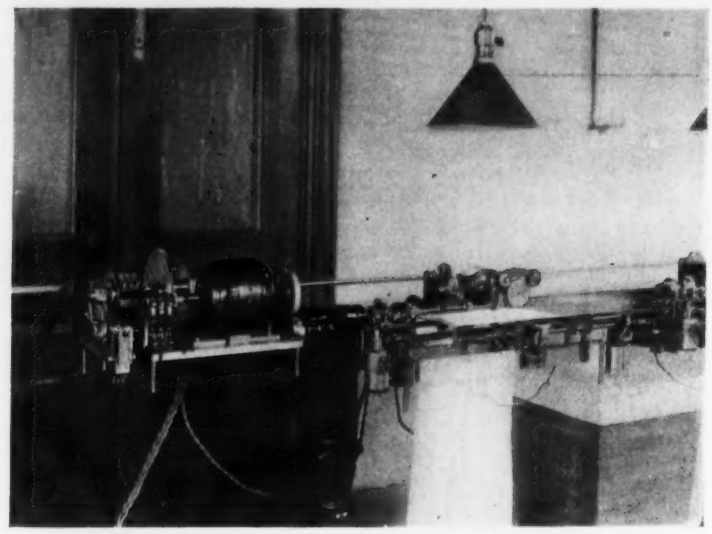


FIG. 11.—SYNCHRONIZER, RECEIVING COMMUTATOR AND LETTER FINDER.

of the remaining three groups, are reserved for purposes of signalling. The signalling can be accomplished in a variety of ways. Morse instruments, one at each end of the line, can be worked duplexed at a slow speed. It is preferable, however, to place at each end of the line, in addition to the four-page printers, a small tape printer, which print simultaneously at the rate of fifteen words a minute each. While the eight printers of the duplex system are in operation, for the transmission of telegrams, the two stations can correspond with each other regarding the business of the offices, or for the purpose of correcting errors. The system, therefore, may be called, with propriety, a "Decaplex" system.

The new machines have the additional important feature that all

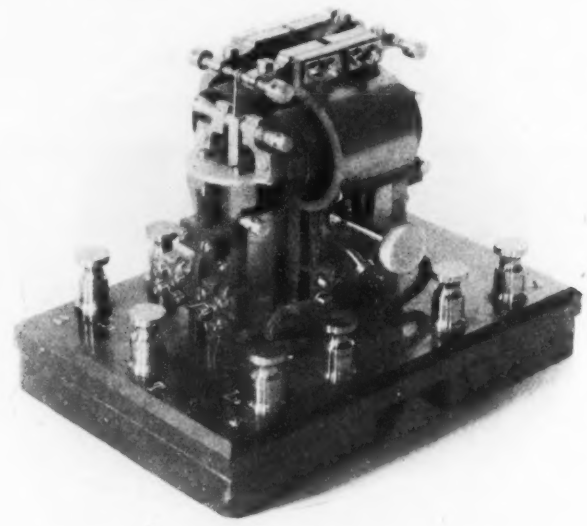


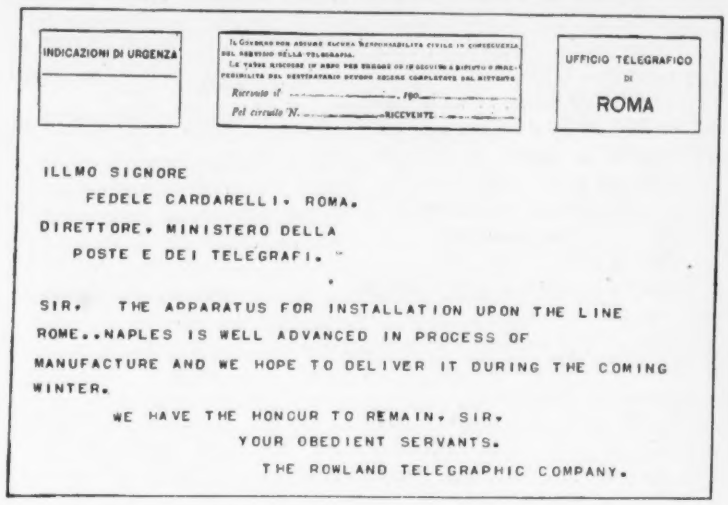
FIG. 12.—MAIN-LINE RELAY.

the messages transmitted are simultaneously recorded at the sending station. The recording at the sending station is done on a tape in printed characters. The tape passes directly over the keyboard and before the eyes of the keyboard operator. (The illustrations represent the tape-recorder raised to the level of the eyes of the operator but in the latest form developed it passes directly over the keyboard.) This home-recording of the messages is accomplished without loss of speed in the eight regular transmitters and without additional complication in the keyboards.

A feature of the apparatus, as now constructed, is the manner in

which it is subdivided into interchangeable units. Each printer, keyboard, bank of relays, transmitter, and the main-line relay constitute an independent unit, which, in case of a failure or a breakdown, can be replaced by another like unit. As such an interchange can be effected instantly, neither the apparatus as a whole, nor any portion of it, is put out of operation more than a moment by the mechanical failure of any of its parts.

The system is kept in electrical adjustment, as far as the main line is concerned, much more easily than are other telegraphic systems.



INDICAZIONI DI URGENZA

UFFICIO TELEGRAFICO DI ROMA

Ricevuto il ..... 190...

Pel circuito N. ..... RICEVENTE .....

ILLMO SIGNORE
FEDELE CARDARELLI. ROMA.
DIRETTORE. MINISTERO DELLA
POSTE E DEI TELEGRAFI.

SIR. THE APPARATUS FOR INSTALLATION UPON THE LINE ROME..NAPLES IS WELL ADVANCED IN PROCESS OF MANUFACTURE AND WE HOPE TO DELIVER IT DURING THE COMING WINTER.

WE HAVE THE HONOUR TO REMAIN. SIR.
YOUR OBEDIENT SERVANTS.
THE ROWLAND TELEGRAPHIC COMPANY.

FIG. 13.—SPECIMEN OF PRINTING.

The duplex line is thrown out of balance only by a considerable change in the insulation resistance of the line. Actual trial has shown that a 300-mile line can be connected to earth at its middle point, through only 2,000 ohms' resistance, without upsetting the duplex adjustment sufficiently to spoil the printing.

In view of its maintenance in electrical adjustment and its interchangeable units, the system may be kept operative under conditions which would upset any other than the Morse system operated simplex.

The octoplex system can transmit to greater distances without relaying than other multiplex systems hitherto known. It has been successfully operated under government tests over lines of 550 miles, and it is anticipated that it will work perfectly, without relaying, between New York and Chicago. Methods have, however, been devised by Professor Rowland for automatically relaying the messages.

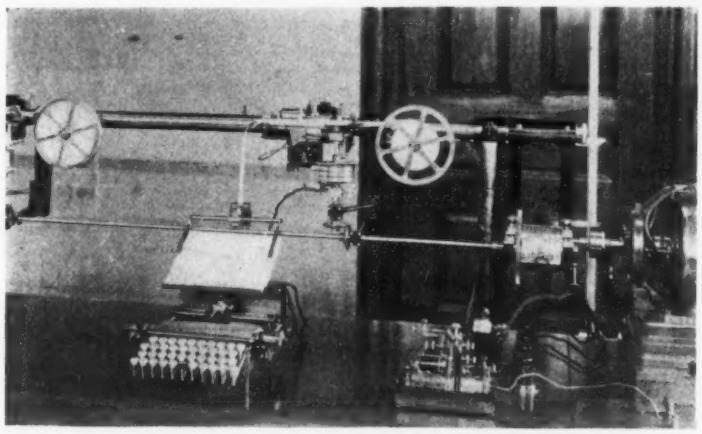


FIG. 14.—KEYBOARD, HOME RECORDER, TRANSMITTER (MAIN LINE), RECEIVING COMMUTATOR.

The instrument shown in Fig. 18 is used with the present octoplex as an additional auxiliary unit for executive correspondence over the line, without interference with the regular work of the octoplex transmitter. It, therefore, renders the capacity of the "octoplex" outfit decaplex. This represents the latest modification of the apparatus; it is the basic unit of the system, and includes a transmitter, a page-printer, a tape-home-recorder and its own synchronizer. All the combinations and the differentiations of the system will be effected by different arrangements of these basic units. There will be other units for the purpose of effecting line operation. In a telegraph operating room supplied with a number of these single-outfit units, it will be possible to move the machines about at will, in order to give a greater or smaller multiplex capacity to any telegraph line, according to the exigencies of the moment.

The system has advantages in the operation of lines subject to line disturbances. As the alternating current is employed, condensers may be used in series with the main-line relays; no amount

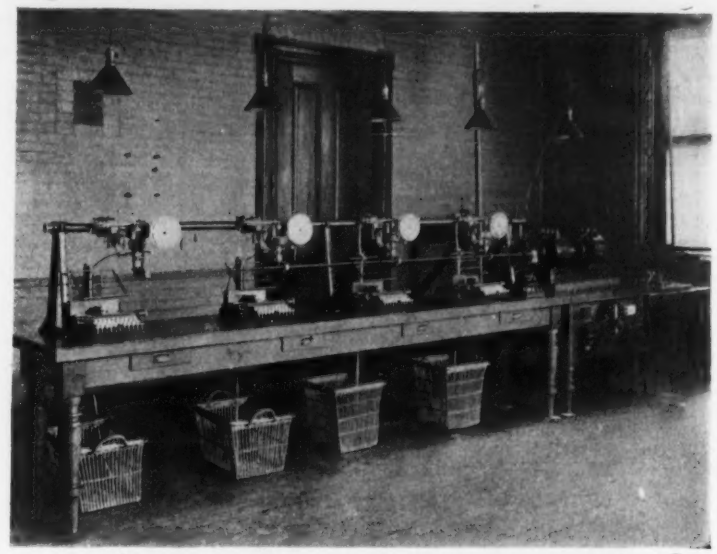


FIG. 15.—OCTOPLEX SINGLE POST, SHOWING GENERATOR TO RIGHT.

of direct current on the line, resulting from leakage to trolley lines, etc., can produce a harmful disturbance.

METHODS OF LINE OPERATION.

Aside from the operation of the system between two main terminal stations, most of the applications which involve the division of its octoplex capacity of transmission amongst stations separated by a considerable distance require the use of some sort of automatic relaying device. An automatic relay for the Rowland system is constructed in one of several different ways; for general use, the following method is considered the best, on account of its flexibility. The general idea may be expressed in a few words:

At a relaying station, the incoming signals are received on a bank of eleven selecting relays, in the same manner as at a terminal station. These relays, instead of operating an automatic printing de-

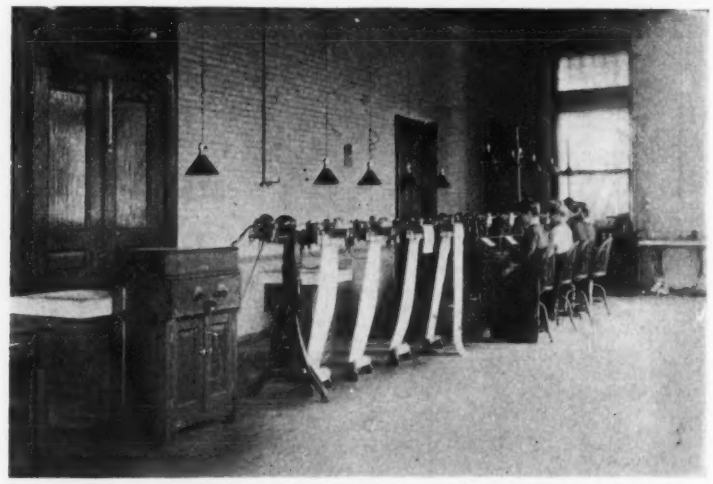


FIG. 16.—COMPLETE OCTOPLEX SENDING AND RECEIVING POST.

vice, have their eleven contacts connected to a sending commutator, in the same manner as the contacts of a keyboard; they operate the usual transmitter which transmits the proper modifications to an alternating current impressed upon the local line by a dynamo at the relaying station. This dynamo is run in synchronism with the dynamo at the originating terminal, or with the dynamo at the main central of the system.

Diagrams, with a brief statement of the operation in each case, are here shown, to illustrate various applications of the Rowland system. It is not deemed necessary, in the present article, to enter

into the technical details of these systems of operation; but it may be remarked that only such are presented as have been experimentally proved as operative, or used in the operation of actual lines.

In regard to all of these methods, some general remarks, which apply to all, may be made. In all cases, the octoplex capacity may be distributed in any convenient manner; that is, in place of having eight operators, at a speed of 40 words per minute each, the number of operators may be doubled and the speed of each halved; or any number of operators may be had, with the limitation that the aggregate speed of the apparatus shall not exceed that of the eight operators at 40 words. In cases where branch lines radiate from a central, these lines may be 300 miles long or longer. Or, in case of slightly different apparatus, placed at the terminal of the branch, these branches may have any length up to the maximum of the system. Way station lines may have any length up to 300 miles.

FIG. 17.—RECEIVER.

In Fig. 19 are shown two centrals, 1 and 2, connected by a trunk line. Passing out from each central is a branch containing a number of stations in series. At 1 and 2 there is an automatic repeater, comprising:

Dynamo and motor.
Two sending commutators.
Two receiving commutators.
Three main line relays.
Three transmitters.
Two banks of selecting relays.

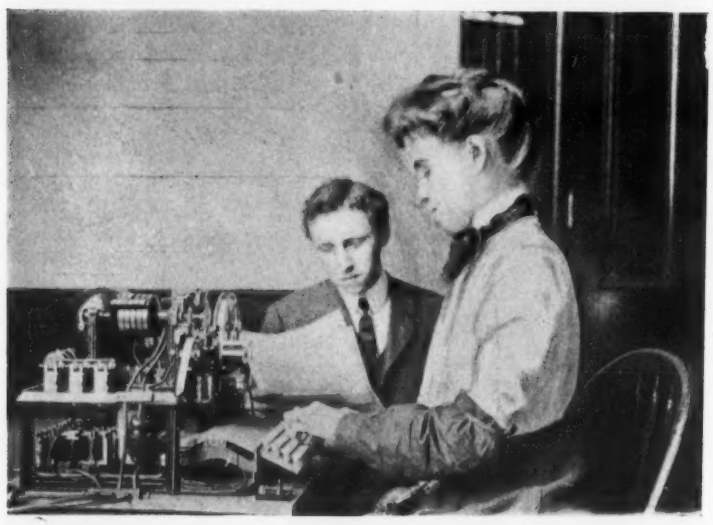


FIG. 18.—SINGLE-OUTFIT UNIT.

At the way stations *A*, *B*, *C*, etc., is a simple or multiple outfit, as the case might be, comprising:

Synchronizer.
One sending commutator.
One receiving commutator.
One to four banks of selecting relays.
One transmitter.
One main line relay.
One to four keyboards.
One to four home recorders.
One to four printers.

Communication may be established so that one station, *A*, corresponds with another, A_1, another station, *B*, to a station, B_1, or, by additions to the apparatus, more complicated and general methods of communication may be established, if such should be desirable.

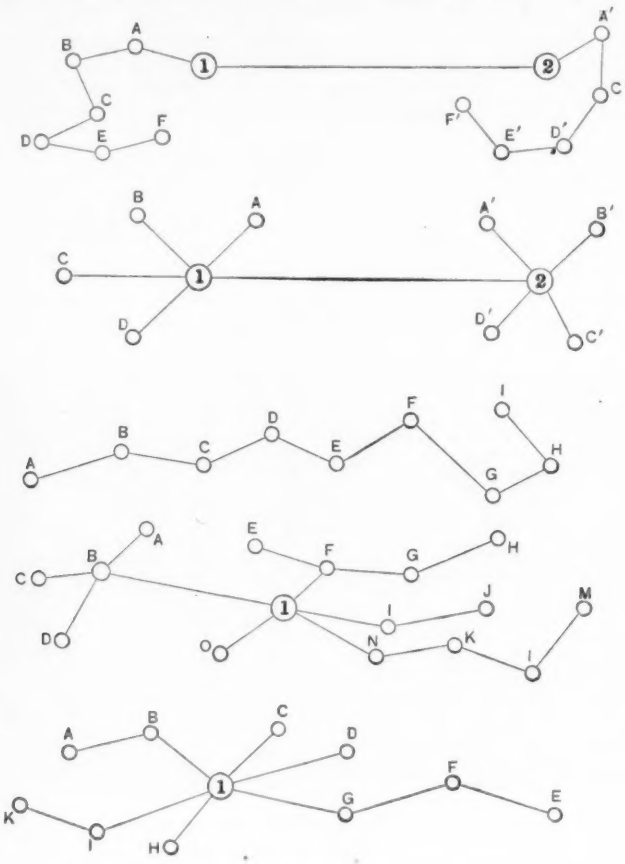
Fig. 20 shows two centrals, 1 and 2, connected by a trunk line, and, at each central, a number of radiating termini. At each central is an automatic repeater. At each branch terminal, *A*, *B*, etc., is a single or a multiple outfit, as desired. As in Fig. 14, correspondence between particular stations, such as *A* and A_1 can be established, or, by additions to the apparatus, any station may be made to communicate with any other, at will.

In Fig. 21 is shown a way station line. A number of stations are connected in series. At *A* is the apparatus:

Dynamo and motor.
One sending commutator.
One receiving commutator.
One to four keyboards.
One to four home recorders.
One to four printers.
One to four banks of selecting relays.
One transmitter.
One main-line relay.

At *B*, *C*, etc., are single or multiple outfits. Here independent communication may be had between *A* and any other station or stations, to the extent of four, each station having a rate of 40 words a minute. These messages may be all received at *A*, or all sent from *A*, or *A* may receive part and send part up to a total of four.

In Fig. 22 is shown a distributing system. Here the apparatus at the various points is substantially the same as given at various corresponding points of the systems previously described. In this system, a keyboard, operated at 1, will simultaneously operate automatic printing devices at all the points of the system.



FIGS. 19 TO 23.—VARIOUS LINE OPERATIONS.

In Fig. 23 is shown another distributing system, which has the addition of transmitting devices at all the substations. The operator of a keyboard at any point of the system transmits the same matter simultaneously to all other points of the system. Any number of operators distributed among the various stations in any manner may be operating at the same time, up to the total capacity, in this case 160 words per minute.

Underground Work for Telephone Exchanges—IX.

BY ARTHUR V. ABBOTT, C. E.

COST OF CONDUITS.

THE cost of a conduit system will be directly proportional to its length, and depends on, but will not be exactly proportional to, the number of ducts. This is almost self-evident, for slight consideration shows that certain of the items of expense are independent of the number of cable spaces, others are partially dependent thereon, while the remainder vary directly with the number of ducts installed. Thus, the cost of manholes will be the same whether few or many ducts are placed; engineering expense, the cost of lighting, watching, protecting and cleaning the street will be the same irrespective of the size of the subway. For necessary working room a certain width of trench must be opened, and if the required number of ducts does not need a wider trench the cost of excavation and paving will be constant. When, however, a greater number of ducts is to be placed, a wider trench than is essential for working room must be excavated, and then the cost of excavation and paving will become partially proportional to the number of ducts. Finally, the expense of the duct material, the cost of labor of laying and that of the surrounding concrete encasement will depend exactly upon the number of ducts.

Item.
Excavation .....
Repaving .....
Trap .....
4 in. pipe .....
Cleaning .....
Permit .....
Totals .....

The fundamental items of cost entering into the expense of conduit construction are ten in number:

1. Duct material. 2. Cement. 3. Sand. 4. Broken stone. 5. Brick. 6. Wrought iron. 7. Cast iron. 8. Lumber. 9. Paving materials. 10. Labor. (a) Skilled labor. (b) Unskilled labor.

TABLE NO. 1.

Cost of Manholes in Dollars.

a. Brick with brick roof.

Item.	Amount.	Rate. Min.	Ave.	Max.	Min. Amt.	Per cent.	Ave. Amt.	Per cent.	Max. Amt.	Per cent.
Excavation	375 cu. ft.	.02	.03	.04	7.50	12.6	11.25	11.8	15.00	11.2
Concrete	.7 yards	5.00	7.00	9.00	3.50	5.9	4.90	5.3	6.00	4.4
Brick	2200	12.00	15.00	18.00	26.40	44.5	33.00	35.3	39.60	29.4
Cover	1	5.00	10.00	15.00	5.00	8.4	10.00	10.6	15.00	11.2
Iron	500 lbs.	.015	.03	.05	7.50	12.6	15.00	16.1	25.00	18.6
Repaving	6 yards	.75	2.00	4.00	4.50	7.6	12.00	12.8	24.00	17.8
Cleaning	10 loads	.50	.75	1.00	5.00	8.4	7.50	8.1	10.00	7.4
Totals					59.40	100	93.65	100	134.60	100

b. Brick with concrete roof.

Item.	Amount.	Rate. Min.	Ave.	Max.	Min. Amt.	Per cent.	Ave. Amt.	Per cent.	Max. Amt.	Per cent.
Excavation	375 cu. ft.	.02	.03	.04	7.50	14.8	11.25	14.4	15.00	13.8
Concrete	1.9 yards	5.00	7.00	9.00	9.50	18.7	13.30	17.0	17.10	15.7
Brick	1600	12.00	15.00	18.00	19.20	37.8	24.00	30.9	28.80	25.7
Cover	1	5.00	10.00	15.00	5.00	9.0	10.00	12.8	15.00	13.8
Repaving	6 yards	.75	2.00	4.00	4.50	8.9	12.00	15.4	24.00	21.9
Cleaning	10 loads	.50	.75	1.00	5.00	9.9	7.50	9.5	10.00	9.1
Totals					50.70	100	78.05	100	109.90	100

c. Concrete manhole.

Item.	Amount.	Rate. Min.	Ave.	Max.	Min. Amt.	Per cent.	Ave. Amt.	Per cent.	Max. Amt.	Per cent.
Excavation	375 cu. ft.	.02	.03	.04	7.50	16.8	11.25	15.5	15.00	14.3
Concrete	4.5 yards	5.00	7.00	9.00	22.50	50.5	31.50	43.6	40.50	38.8
Cover	1	5.00	10.00	15.00	5.00	11.2	10.00	13.9	15.00	14.4
Repaving	6 yards	75.	2.00	4.00	4.50	10.2	12.00	16.6	24.00	23.0
Cleaning	10 loads	.50	.75	1.00	5.00	11.3	7.50	10.4	10.00	9.5
Totals					44.50	100	72.25	100	104.50	100

These fundamental units will vary with different localities and times. For ease in calculation it is convenient to express these fundamental costs in certain derived units, and to assign to each such a range of variation as is likely to cover probable change within reasonable place and time limits. The derived units are:

1. Duct material. 2. Pavement per square yard. 3. Street excavation per cubic foot, including the removal of paving, the refillment of the excavation after the ducts are laid, and the temporary replacement of the paving. 4. Concrete deposited in place. 5. Labor of placing duct material. 6. Engineering expenses. 7. Manholes. 8. Removal of obstacles.

Of all these derived units, the cost of manholes is least dependent on the number of cable spaces, the cost of this item varying only with the total cost of each manhole and the distances apart that they are set. Table No. 1 gives the itemized cost of various types of manholes. For each item three prices are given: One a minimum price, estimated as that required under the most favorable circumstances; second, an average price, that which is likely to obtain under usual conditions; and, third, a maximum price, or that likely to be required under the more severe requirements of congested city construction, and where work has to be prosecuted at least partially out of working hours to avoid too great interruption to traffic. For each price a parallel column to that showing the cost of the various items is given, in which the percentage that each item bears to the total cost is calculated. Therefore, with any change in the unit prices, it is easy to estimate the effect that this change will have upon the total cost.

TABLE NO. 2.

Cost of Sewer Connections in Dollars.

Amount	Rate. Min.	Ave.	Max.	Min. Amt.	Per cent.	Ave. Amt.	Per cent.	Max. Amt.	Per cent.
225 cu. ft.	.02	.03	.04	4.50	35.1	6.75	26.0	9.00	21.4
5 yards	.75	2.00	4.00	3.75	29.2	10.00	38.8	20.00	47.0
1	1.00	2.50	4.00	1.00	7.6	2.50	19.6	4.00	9.3
16 ft.	.04	.07	.10	.64	5.0	1.12	4.4	1.60	3.6
2 loads	.50	.75	1.00	1.00	7.6	1.50	5.8	2.00	4.7
1	2.00	4.00	6.00	2.00	15.5	4.00	15.4	6.0	14.0
				12.89	100	25.87	100	42.60	100

Whenever practicable, a sewer connection to each manhole is desirable to provide exit for street drainage. Such sewer connections are essential in all cases where manholes are equipped with ventilating covers, otherwise the manholes will assuredly fill during every storm. Cases will arise when, either due to the absence of sewers, or to their relative grade with reference to the manhole bottom, a connection of this kind is impracticable; and so the cost of sewer connections has been estimated separately, and is shown in Table No. 2. This table is prepared in a similar manner, a minimum, average and maximum price being shown, and the percentage of each item to the total calculated.

Manholes will occur at intervals of from 250 to 500 feet, consequently the constant cost per conduit foot for this item is obtained by dividing the various manhole costs by the ristances between them. In Table No. 3 manhole cost per conduit foot for each of the various styles of manholes given in Table No. 1 for a minimum, average and maximum price is calculated for distances from 250 to 500 feet, varying by 50 feet. In this table the cost of sewer connections per foot of street is included, calculated in a similar manner. For example, assume concrete manholes spaced 300 feet apart, with average cost price. The cost per foot of conduit for manholes will be 24.2 cents, the cost of sewer connections 8.6 cents; a total of 32.8 cents.

Engineering expense is difficult to estimate, as this item will depend chiefly upon the care and thoroughness with which the conduit is laid. The calculation of this item is best obtained as a "factor of experience," namely, such an amount as extended practice in building large systems of conduit has in the past shown to be adequate for the purpose. Upon this basis, engineering expense will vary from a minimum of 5 cents per conduit foot to a maximum of 12 cents, depending chiefly upon the difficulty of the work.

The cost of the removal of obstacles is another item impracticable to estimate *a priori* with any degree of certainty, as it is impossible

to foresee, and usually impracticable to ascertain, even with the greatest care, the impediments to be encountered beneath street surfaces. Here also a resort to experience is necessary to ascertain the amount required for this purpose. The cost of the removal of obstacles falls into the category of semi-variables, for it is evident that a large subway will require a greater expense for this purpose than a small one. But this expense is by no means directly proportional to the number of ducts installed. Experience indicates that this expense will vary for small subways from 10 cents to 62 cents per foot of conduit; for medium sized ones from 12 cents to $1.10, and for large conduits from 15 cents to $1.25.

TABLE NO. 3.

Constant Cost per Conduit Foot for Manholes in Dollars.

		Distance between manholes in feet.				
		250	300	350	400	500
Brick Manhole with Brick Roof	Min.	.238	.196	.170	.148	.118
	Ave.	.372	.310	.248	.236	.186
	Max.	.536	.427	.384	.335	.268
Brick Manhole with Concrete Roof	Min.	.203	.169	.145	.127	.102
	Ave.	.300	.260	.223	.195	..156
	Max.	.440	.363	.314	.272	.218
Concrete Manhole	Min.	.176	.148	.127	.111	.089
	Ave.	.278	.242	.209	.180	.144
	Max.	.416	.347	.298	.260	.208
Sewer Connection	Min.	.051	.043	.038	.032	.025
	Ave.	.104	.086	.074	.064	.051
	Max.	.170	.142	.121	.105	.084

The cost of paving is partially dependent upon the number of ducts. It is impracticable for workmen to perform their avocations in a trench less than 18 inches wide, and, therefore, a strip of pavement of this width must be opened irrespective of the number of ducts to be installed. Experience shows that in such a trench it is possible to install three ducts horizontally, and the same number vertically. Consequently in an 18-inch trench the advisable maximum number of conduits is 9; so the cost of paving will be constant for any number of ducts from one to nine. To place more than three ducts horizontally requires the trench to be opened three or four inches wider, which will require a corresponding amount of repaving. Therefore, for from 9 to 16 ducts the cost of repaving is again constant. Similarly, the amount of repaving per foot of conduit will increase by three or four inches for each additional duct placed horizontally, while the number of ducts will increase in proportion to the square of this number.

The cost of repaving will further vary with the kind of paving. In Table No. 4, the usual kinds of pavement encountered, the minimum, average and maximum prices per square yard, and cost per conduit foot are given.

Allowing a disturbance of paving for six inches on each side of the trench, the cost per lineal foot for small conduits will vary from 2.3 to 26.3 cents; for medium sized ones from 4.6 to 29.2 cents, and for large conduits from 6.9 to 35.0 cents.

Similarly the cost of excavation is only partially dependent upon the number of ducts. The necessary width of trench to give working room, and depth to clear gas and water service pipe, will accomodate nine ducts, and so the cost of excavation is constant for this number. For from 9 to 16 ducts four inches additional width and depth must be provided, and for each additional layer of cable spaces horizontally and vertically four inches additional excavation in width and depth must be provided. Experience shows that 3 feet 6 inches is a minimum permissible depth for the bottom of subway construction, and that the cost of street excavation will vary from two to four cents per cubic foot of material excavated, including the removal of the pavement, the refillment of the trench and the replacement of temporary paving. The cost of excavation will, therefore, stand as in Table No. 5.

Table No. 6 will summarize these constant items: conduits of from one to nine ducts, ten to sixteen ducts, and seventeen to twenty-five ducts, giving the minimum, average and maximum prices of all, together with the percentage that each bears to the total. This table shows that conduits containing nine ducts or less will cost from 32.4 cents to $1.60 per lineal foot for street work; those containing 10 to 16 ducts, from 41 cents to $1.87, and those containing from 17 to 25 ducts, from 52 cents to $2.34. If to these prices the cost per foot of street for manholes be added, as given in Table No. 3, it is easy to calculate the total cost per foot of conduit exclusive of duct material for any desired subway. For example, assume a subway of nine ducts, with brick manholes set 350 feet apart, at average prices the manhole cost is 22.3 cents, sewer connections 7.4 cents, other items (from Table No. 5) 67.25 cents; total cost per foot of street, exclusive of duct material and laying the same, 96.95 cents.

The cheapest form of duct material is hollow brick, depending upon distance from factory and freight rates, the price f. o. b. cars will vary from 1.6 cents to 3 cents per duct foot; adding expense of inspection, hauling, cleaning, breakage, etc., 2 to 5 cents per duct foot will be the cost delivered along side the trench. Multiple duct material stands next, costing from 3 to 5 cents f. o. b. cars, or from 3.5 to 6.5 cents per foot on the trench. Cement-lined pipe and cement pipe will cost from 4 to 8 cents on the street, and creosoted wood from 4 to 6 cents.

The cost of placing duct material in the trench varies considerably with the kind employed. Hollow brick has been classed by trades unions as brick masonry, owing to the use of a trowel in laying; for this reason, and from the large number of pieces that must be handled, the expense of placing single-duct material is greater than that of either the multiple duct, cement-lined pipe or cement pipe. The cost of placing hollow brick, including the necessary mortar, may be taken from ½ to 1½ cents per duct foot. The cost of placing multiple duct material will vary from .1 cent to 1 cent, depending on the size of the pieces and the difficulties of the trench. Cement-lined pipe and cement pipe cost less to place than hollow brick and more than multiple ducts, varying from .25 cents to 1 cent per duct.

TABLE NO. 4.

Cost of Paving per Square Yard and per Foot of Conduit in Dollars.

Kind of Paving.	Min. Price per Sq. Yard.	Cost per Conduit Foot. Ducts from 1 to 9 .0925 sq. yd.	10 to 16 .105 sq. yd.	17 to 25 .117 sq. yd.	Ave. Price per Sq. Yard.	Cost per Conduit Foot. Ducts from 1 to 9 .0925 sq. yd.	10 to 16 .105 sq. yd.	17 to 25 .117 sq. yd.	Max. Price per Sq. Yard.	Cost per Conduit Foot. Ducts from 1 to 9 .0925 sq. yd.	10 to 16 .105 sq. yd.	17 to 25 .117 sq. yd.
Asphalt	1.75	.163	.183	.205	2.00	.185	.210	.234	3.00	.276	.315	.350
Asphalt block	2.25	.208	.218	263	2.50	.231	.262	.292	3.00	.276	.315	.350
Granite block	1.50	.138	.157	.176	1.75	.163	.172	.205	2.50	.231	.262	.293
Cedar block	.60	.056	.063	.070	.75	.069	.079	.088	1.00	.092	.105	.117
Brick	1.25	.115	.131	.146	1.50	.138	.157	.176	2.50	.231	.262	.293
Telford	.80	.074	.084	.093	1.00	.092	.105	.117	1.25	.116	.132	.146
Macadam	.25	.023	.026	.029	.50	.046	.052	.058	.75	.069	.079	.088

TABLE NO. 5.

Cost of Street Excavation per Conduit Foot in Dollars.

	Minimum .02 per cu. ft.	Average .03 per cu. ft.	Maximum .04 per cu. ft.
1 to 9 ducts	.105	.1575	.210
10 to 16 ducts	.160	.240	.320
17 to 25 ducts	.225	.3375	.450

Cars and Cabs in Vienna.

The cabmen in Vienna are feeling the competition of electric cars, and have decided to send a petition to the burgomaster and the Municipal Government demanding indemnity for their unremunerative licenses at $600 each; or, should this plan fail, they will themselves pay the said sum for each license now in operation, provided no more be issued. They prefer the first alternative, for, with the $600 and the money derived from the sale of their carriages and horses, the men hope to set up in some other business. There are 1,000 two-horse public open carriages in Vienna, and their owners have for many years monopolized all first-class traffic and have even controlled the number of licenses annually issued.

District Central Station Plant in England.

AS we have from time to time noticed in these columns, a central-station development which promises to take large proportions, is the supply of a large number of towns from a single generating station. Recently we described two such plants in New Jersey, one of which supplies no less than 35 towns, the majority having previously had local central stations. In view of the interest which exists in this subject, we give below a description of an English example of this system of electrical supply, the plant of which has recently been completed. In this case there is an additional interest from the fact that the distribution throughout the entire district is by underground cables. The accompanying map shows the area of distribution, though at present only the shaded portions are served. The district is quite a small one, the radius only being about seven miles, but this was considered to be the maximum over which underground distribution would be economical, in view of the cheapness of coal at the point of generation, the plant being situated in the heart of the "Black Country," thus approaching the ideal of a generating station at the pit's mouth.

The power station is situated on the Birmingham canal, and a branch railway line also runs alongside of it. The coal and ashes are handled by a Hunt conveying plant, having a capacity to deal with from 400 to 500 tons of slack per day, the bunker capacity being

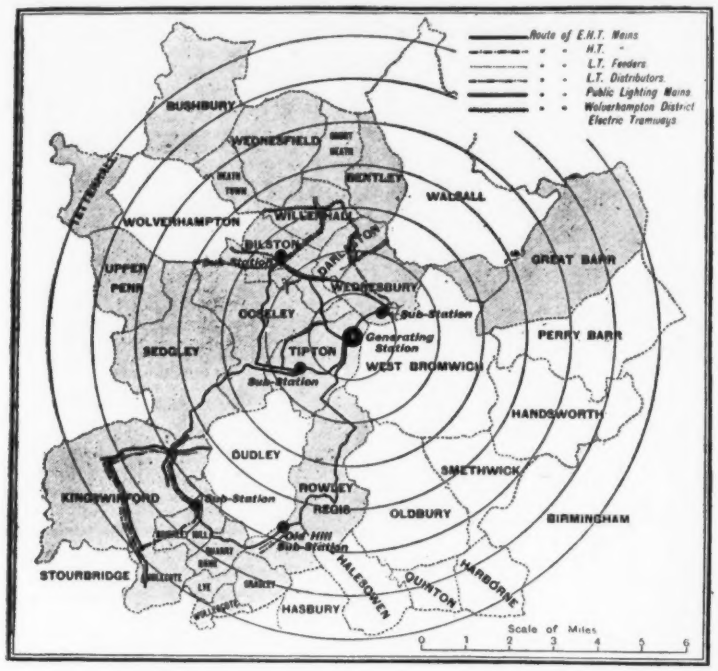


FIG. 1.—MAP OF DISTRICT.

900 tons. In the boiler house there are eight Babcock & Wilcox boilers, arranged in pairs, each having a capacity of 12,000 pounds of water evaporated per hour and at from 212° F. The boilers are fitted with chain grate stokers and superheaters.

So far the engine room contains only two 800-kw alternators and one 1,500-kw alternator. There is space for two more sets of the larger size without prolonging the engine room, and there is sufficient land unoccupied to lengthen the engine room to three or four times its present size at least. The alternators generate two-phase currents directly, at 7,500 volts. All three are of Messrs. Ferranti's make, the two smaller ones being driven by Ferranti engines, and the larger one by a Yates and Thom engine. One of the smaller sets is seen in Fig. 3, and a drawing of the 800-kw alternator in Fig. 4. Both engines are of the vertical cross-compound type. The Ferranti engines run at 166 r. p. m., and the Yates and Thom engine run at 90 revolutions.

The dynamos differ but slightly in general design from Messrs. Ferranti's well-known moving magnet single-phase type. Their armatures are tunnel wound, the windings being cotton-covered and placed in micanite tubes. The magnets have cast-steel pole pieces, and the magnet coils are wound with insulated copper strip on edge. The windings of the two phases on the alternators are kept quite independent. A frequency of 50 ~ per sec. has been adopted. Each unit is capable of working continuously at 25 per cent. overload, with a power factor of 0.8. The flywheel consists of a central boss of cast steel shrunk upon the crank shaft. The rim of the wheel is of cast iron, and is in one piece. The spokes which connect the rim to the central boss are mild steel bolts screwed into the central boss.

The method of building up is as follows: The wheel is adjusted to come concentric with the shaft, the bolts being screwed up as tight as is possible by means of clamps on the center portion of the

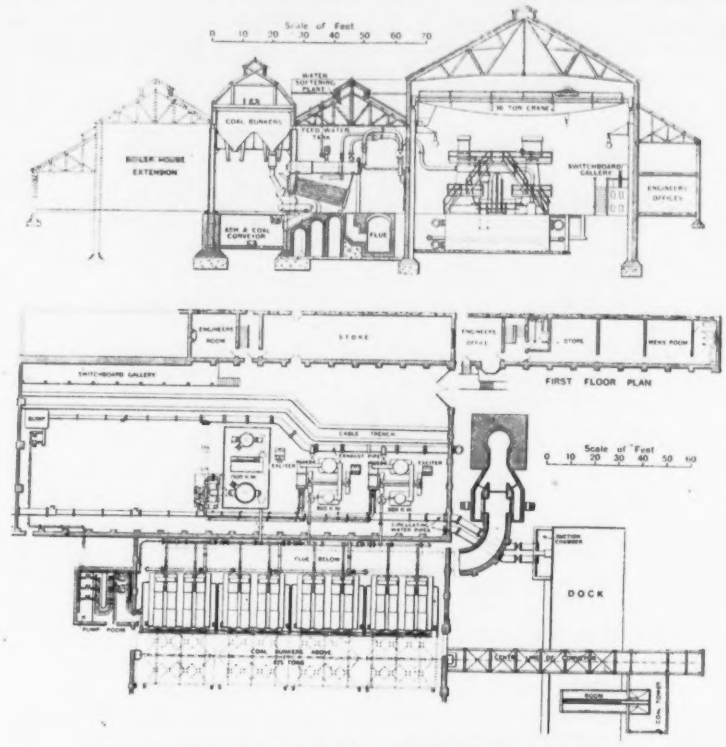


FIG. 2.—SECTION AND PLAN OF GENERATING STATION.

bolts. The bolts are then heated so as to elongate them, afterwards screwed up whilst hot, and on cooling put a compressive stress in the rim of the flywheel. The wheel rim is then machined true, and the field magnets are bolted in position upon it. In the case of the 800-kw machines, the peripheral speed of the rim of the flywheel is

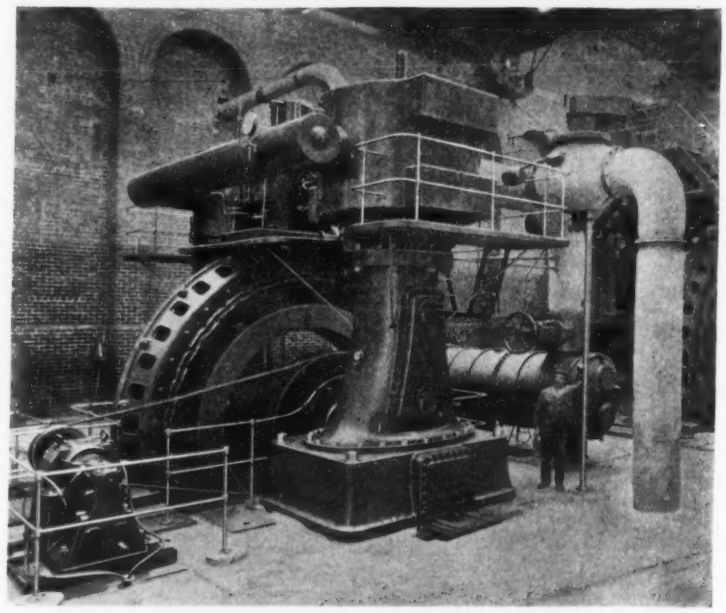


FIG. 3.—ONE OF THE 800-KW GENERATING SETS.

5,800 feet per minute, and the peripheral speed of the outer face of the magnet is 6,800 feet per minute. The stress in the cast iron, due to the centrifugal strain put upon it by both the field magnets and its own centrifugal force amounts in the weakest section to one ton per square inch, assuming that no benefit is to be obtained from the initial compressive stress explained above. The stress on each bolt arm is only 3½ tons per square inch on the weakest section, to resist a centrifugal force of both rim and field magnets.

The 1,500-kw alternator is built on similar lines to the 800-kw, as

far as is shown in Figs. 3 and 4, but as in this instance both the engine and flywheel are supplied by Messrs. Yates and Thom, the construction of the wheel is different.

On the two smaller sets, the exciters and the circulating and air pumps of the surface condensers are rope-driven from a pulley on the main shaft. The exciters are 100-volt, 60-ampere machines. Ropes from the same pulley on the shaft pass underneath the engine room floor, over a jockey pulley, which drives the centrifugal circulating pump, to the pulley of an Edwards air pump. The larger set does not drive its air and circulating pumps, these being separately-driven by two-phase motors.

An independent surface condenser of 20,000 square feet cooling

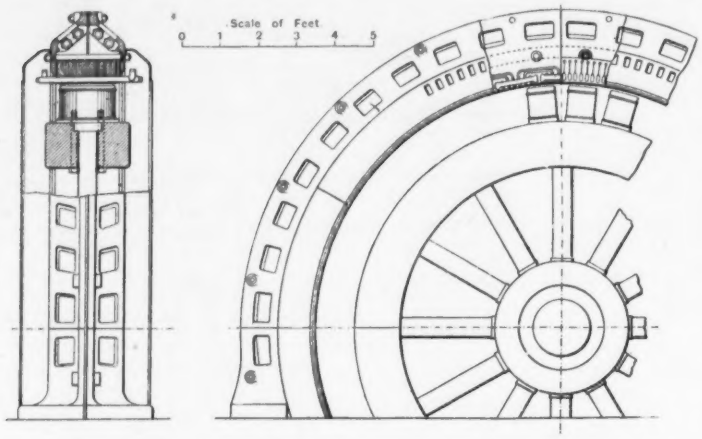


FIG. 4.—800-KW, 7,500-VOLT, TWO-PHASE ALTERNATOR.

surface is placed behind each engine on stools standing on the engine-room floor. The circulating water will be taken from the canal basin, and, as the canal company object to hot water being let into the canal, a cooling tower will be erected. There is a crane spanning the engine room, worked by three two-phase motors, and rated at 25 tons. Running the whole length beneath the engine room is a tunnel for cable, with openings to the machines and switchboard.

One of the most interesting part of the plant at the power house is the switchboard. The switch gear, which has been supplied by Messrs. Ferranti, includes oil-break switches of entirely new design, and a modification of the Ferranti oil-break fuse, both of which are here employed for the first time. Figs. 4 and 5 show in detail the construction of the switch and fuse.

The switches are on the divided-break system. The main contact outside the oil container breaks circuit first, and the final break is in shunt with this, and takes place at the seven blades within the oil vessel, each of the blades, together with the corresponding clip con-

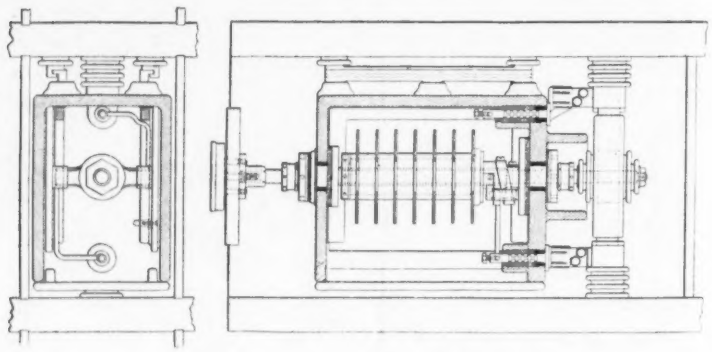


FIG. 5.—EXTRA HIGH-PRESSURE, OIL-BREAK SWITCH.

tact fixed to the interior of the vessel, constituting as it were a double-break switch, so that the spark is divided among 14 breaks in series, and all under oil. In switching off, the handle as it is turned to break the main contacts, winds up a spring, which releases suddenly, and rotates the ambroin sleeve carrying the contact blades. In switching on, there is a synchronizing contact at half-cock, but the break does not pass through this intermediate stage. The box containing the oil and the shunt blades is of porcelain and is quite covered in, and the main break, being at the back of this, and, therefore, at the end of the compartment of the switchboard containing the switch, is also quite inaccessible until the whole piece of apparatus is withdrawn, and contact is thus broken. To facilitate removal, the complete switch is provided with runners. The framework of the board is divided up into compartments similarly to the ordinary Ferranti board, and the two lugs protruding from the bottom of the oil container make contact with clips just as in the Ferranti oil-break fuse for high pressures. Contact with the synchronizing bar is made at the bottom in a more or less similar manner, and, as seen in the illustrations, the fixed contacts are part of the main body of the switchboard. It would appear that some difficulty might be anticipated in the accurate fitting of this contact, but so far everything has worked well, the only detail which has given trouble being the helical spring on the contact spindle, which appears apt to break. This can, however, only be a matter of the temper of the steel, and is, doubtless, already remedied. The switch illustrated has a maximum capacity of 1,000 kw, but switches of this type are intended for alternating-current pressure between 7,000 and 15,000 volts.

The fuses are a modification of the Ferranti oil type. In this case there are a number of breaks—four—in parallel, the fuse-wire in each case being bridged over the top of each pair of the upright porcelain tubes. The main body of the apparatus is made up of a porcelain holder, provided with a handle at the front for removing or replacing the fuse. Into this holder a gunmetal fitting is cemented, containing the necessary contacts for operating the fuse. A spindle, fitted with revolving drums, is placed in this casting, each drum having a clockwork spring fixed to it. A flexible copper conductor is also fastened to the drum at one end, and the other is provided with a suitable coupling, to which the fuse-wire is soldered. The porcelain tubes are clamped into the upper portion of the gunmetal castings by a suitable gland, the bottom of the tube being fitted with an iron plate having a slot cut in it for the passage of the flexible conductor. An insulating field rises between the sets of glands in order to prevent the passage of an arc across the nuts themselves, as these form part of the high-tension circuit.

When made up in position the porcelain tubes just touch one another at the top, and across these joints the fuse wires are stretched and soldered to the ends of the flexible copper strips. Drawn out to their full extent these strips wind up these springs in the barrel on the spindle, and as soon as the fuse melts each strip is quickly pulled down into the oil, with which both the tubes and porcelain box are filled, and an arc is prevented. A lid extending the whole length of the fuse box covers up the fuse wires themselves, and also prevents splashing of the oil when the fuse blows. Each fuse is made up complete with jaws at the back for making connection to spring clips in the fuse panel itself, so that by these means the fuse may be readily withdrawn for examination or replacement. Where it is required to replace the fuse while in operation a short-circuiting device in the shape of a plug can be fitted above the fuse itself.

The contacts at the back of the fuse are enclosed in separate insulating compartments, which entirely prevent the possibility of any

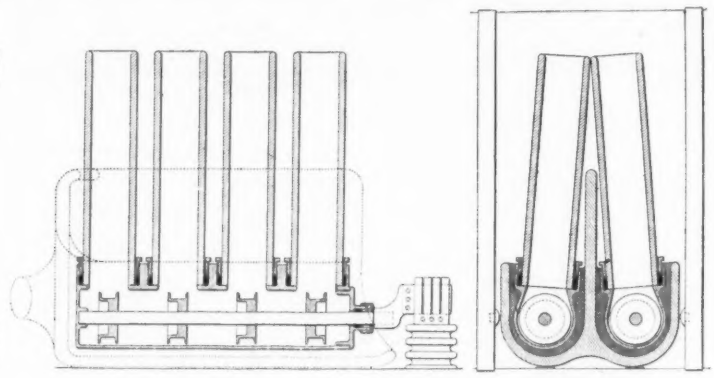


FIG. 6.—EXTRA HIGH-PRESSURE, OIL-BREAK FUSE.

arc passing between the contact jaws themselves. In every case the apparatus is so constructed that it is impossible to receive a shock, even though an attendant may stumble against the board, as all high-tension portions are fitted at the back of the fuse, and in the case of the gland nuts the porcelain holder effectively prevents the possibility of accident from contact. The fuses have proved themselves quite efficient, and with them also the only trouble experienced at the Midland works has been due to the breakage of some of the springs of the fuses first sent out.

The two phases are quite independent on each dynamo, and a pair of lead-covered concentric cables leads up from each machine to the switchboard, rising vertically from below. The feeder cables are two-phase cables, however, with two cores and a common return

concentric with the lead covering. These are also led up to the board, and just below the gallery there is a common earthed bus-bar, to which all the outers are connected. The cables end in small terminal boxes just below this bar, their outers as well as their lead sheathing being connected to the boxes, and short copper links connect the boxes to the outer bus-bar. This is visible in Fig. 7. The switchboard is thus single-pole, the cables rising in the usual manner through the fuses, switches and ammeters. The two high-tension switches forming each pair are mechanically connected by a link, as seen in Fig. 7, and are worked by the same lever; and the same type of switch, fuse and ammeter is used for connecting the feeder to the bus-bar as for connecting the generator to the bus-bar.

The bus-bars rest on insulators on the top slate, and are completely covered in. The standard designs for this board allow of one to three bars being fitted, but in the case under consideration only two are required. Each bar is separated from its neighbor by ambroin division plates, and these are so arranged that it is impossible for any arc to start between the bars. An isolated plug of the expansion type is employed for connecting the panel below to the bus-bar, so that at any time by withdrawing this plug each two-phase panel can be completely cut off from the bars for cleaning purposes, for inspection or for repair. Standing on the top slate in front of the bus-

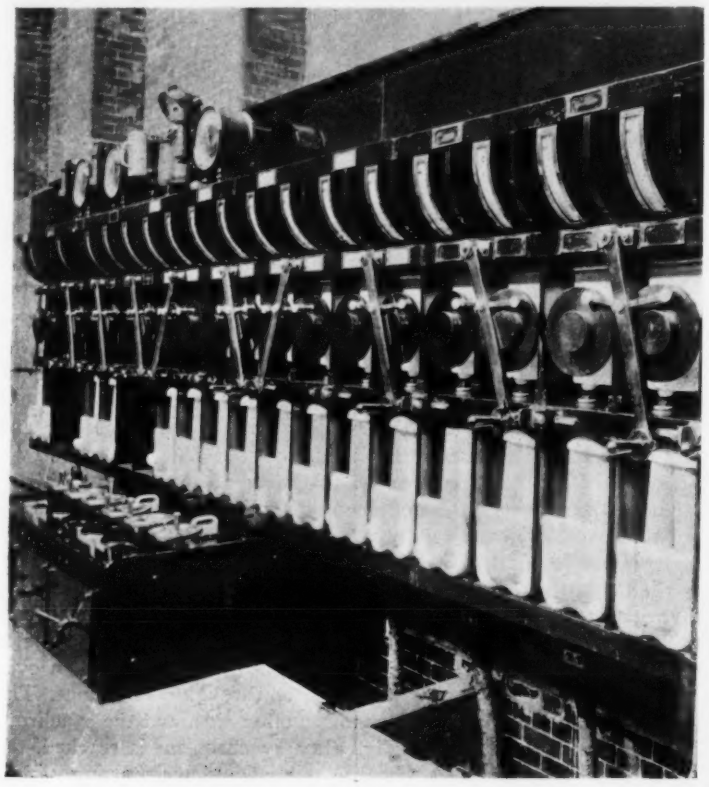


FIG. 7.—EXTRA HIGH-PRESSURE SWITCHBOARD.

bar chamber are the voltmeter and synchronizers, the latter being protected by oil-break fuses, and the former by the water resistance cut-outs already alluded to. By the removal of the water resistance cut-outs or the fuses, the voltmeters and synchronizer can be removed from their terminals without fear of shock.

At present the "mains charger," which is to prevent the momentary rise in high pressure which a sudden switch-on would occasion, is not in position, and it is necessary to run up on the mains. The importance of this matter will be realized when it is mentioned that the capacity between each inner conductor and the other two conductors is 0.25 microfarad per mile in the largest cable, the longest feeder of this size is nearly eight miles in length, and the working pressure is 7,500 volts. The mains charger is simply a water resistance in series with the cable, the plates dipping into the water being gradually lowered until the pressure on the feeder is the same as that on the generator. The synchronizing contact of the feeder switches, which is, of course, not required for synchronizing, is employed for this purpose, the cable being connected up through the water resistance when the switch is in this position.

There are two switchboards in addition to the main board above described, one the meter board and the other the works switchboard for distributing the current used for light and power on the works.

The area to be covered by the Midland scheme and the position of the existing mains and substations are indicated in the map, Fig. 1. Cables of the type shown in section, in Fig. 8, are employed, which represents the largest size. Its two inner conductors are each 0.14 square inch in section, and the common return, which is composed of flat strip, has a sectional area of 0.2 square inch. The

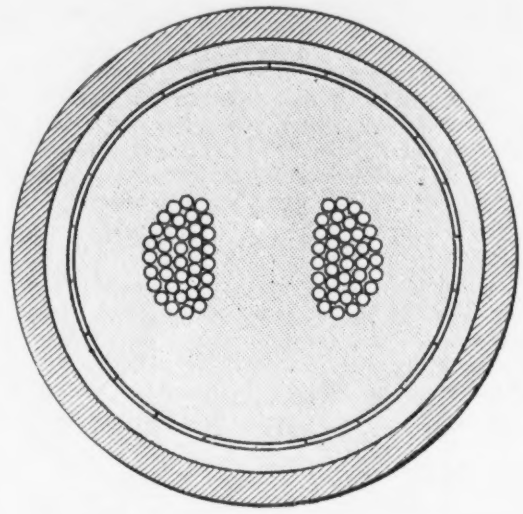


FIG. 8.—SECTION OF CABLE, FULL SIZE.

capacities are as follows: Between the two inner conductors, 0.14 microfarad per mile; between the two inner conductors when one is connected to the outer conductor, 0.25 microfarad per mile; between the two inner conductors connected together and the outer, 0.38 microfarad per mile; and, finally, between the outer conductor and lead sheathing, 3.8 microfarad per mile. The cable is insulated with paper, and is not armored, but outside the lead covering there is a serving of jute impregnated with preservative compound. It is laid at a depth of about 3 feet in earthenware troughs, filled "solid" with pitch and covered with bricks. The troughs (Fig. 9) are of U-

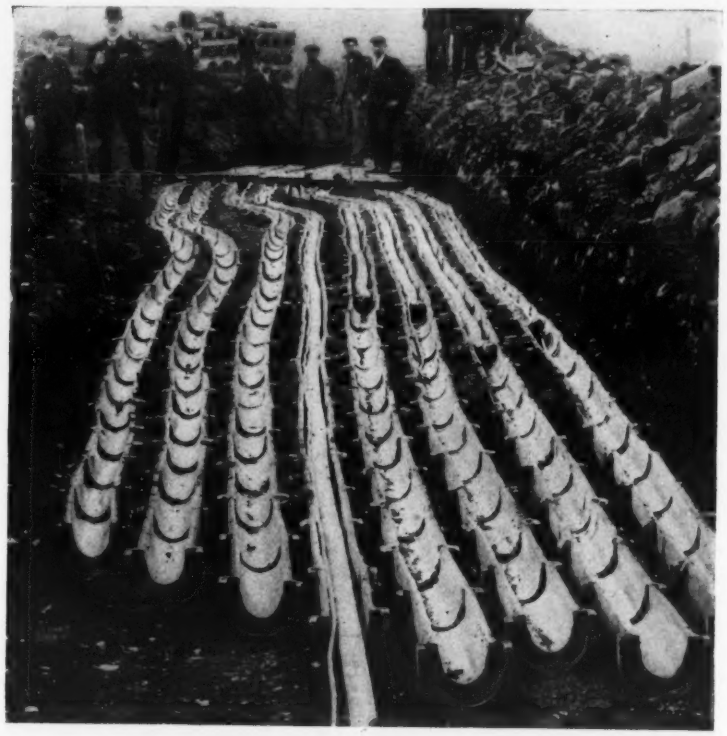


FIG. 9.—CABLE TRENCHES.

section, with spigot and socket joints, and the cable rests on separate bridge pieces.

Subsidences, due to the mining operations in the district, are things to be guarded against, and in places where trouble from this cause might have been expected, a different mode of main laying has been adopted. Lengths of cast-iron piping are used, whose ends are merely butted together, and these are held in place by 2-foot sleeves passed over the ends of the pipe and packed with yarn. In addition

to this increase in flexibility, "loop pits" are provided every 200 yards, in which about 6 feet of slack cable is left, this being passed over rollers so that it is taken up automatically without undue strain in case of a subsidence occurring. One of these "loop pits" is shown in Fig. 10.

The high-pressure and low-pressure cable is lead-covered concentric, and is laid in the same way as the extra high-pressure cable. Double service boxes of the usual pattern, with compound glands, are employed.

Distribution takes place in three ways: Directly from the substation at 200 volts, two-phase; from street transformers, fed at 2,700 volts from the substations, and delivering at 200 volts two-phase to the consumers' networks; and (from the Bilston substation only) at 500 volts continuous current for tramways, through rotary converters.

The general arrangement of the Bilston substation is apparent from Fig. 11. It is seen that the floor is occupied by the stationary transformers and the rotary converters, a rail dividing these two portions, and that the various switchboards (with the exception of the tramway switchboard, which is, so to speak, a lodger) are placed on two low galleries only just above the floor level, and running about half the length of the room by the transformers. Two extra high-pressure cables (both of 0.105 square inch section inner conductors) come in to the substation, and two (0.105 square inch and 0.07 square inch) go out again, the extra high-pressure cables being arranged more or less in a ring to feed the substations. All four cables are led to an extra high-pressure switchboard divided into two parts, and connecting the extra high-pressure mains to the 7,000 : 2,000 and 7,000 : 200 transformers, for the high-pressure and low-pressure distribution, respectively.

The apparatus installed on these boards is of the new Ferranti pattern, similar to that employed at the substation. The transformers which transform down for the rotary converters are not connected to this board directly, there being merely switches to connect the extra high-tension mains to the top of the rotary converter board, to which these transformers are connected. Rubber cables

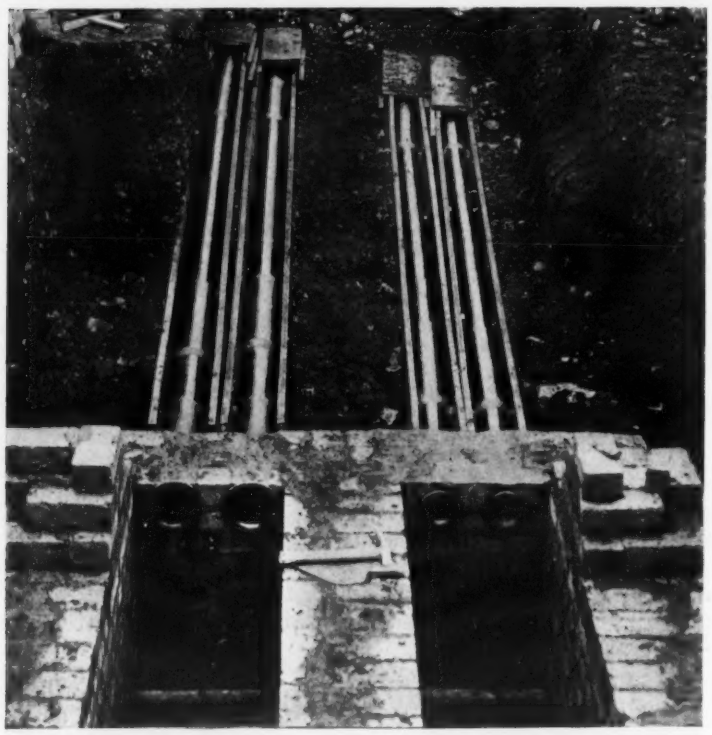


FIG. 10.—LOOP PIT.

on insulators connect these switches with the rotary converter board.

The 7,000 : 2,000-volt transformers, as all the other transformers, will be pairs of separate transformers, one transformer on each phase. From the secondaries of these, mains are led to the high-pressure board, whence feeders will run to Ferranti tank transformers, which will be used in the Willenhall district, the first portion of the company's area to be supplied at this pressure. A low-pressure, two-phase board receives current from two pairs of 50-kw and one pair of 25-kw transformers. One set of switches and fuses connect the transformers to the bus-bars, and the other set are between the feeders and the bus-bars; and in each case the switches of the two-phases are coupled together. Although the mains are two independent concentric cables for the two phases, and the transformers are also separate, both the outers are connected to a common bus-bar, and there are no fuses on these outers except on the consumers' premises. The two-multi-cellular voltmeters are connected one in each phase.

At the top of the converter board are four "time element" cut-outs which are also used as switches, for connecting the two pairs of

FIG. 11.—INTERIOR OF BILSTON SUBSTATION.

step-down transformers which feed the rotary converters to the 7,000-volt bus-bars of the adjacent extra high-tension switchboard. They are fitted with a time-element relay, which it is possible to adjust so that there is an interval of any time up to 10 seconds between the short-circuit and the cut-off. If the short-circuit or excess current is of shorter duration, the cut-out does not fall. Two pairs of 100-kw Westinghouse transformers are connected to these cut-outs, the connections being single-pole, as are all the extra high-pressure switching arrangements. The secondaries of these transformers are brought back to the board to the two pairs of switches in the bottom row but one, which connect them to the slip rings of the rotary transformers. At the bottom of the board are two throw-over switches to switch on induction motors placed on the shafts of the rotaries for starting them. When the switch is thrown over to one side, the induction motor is started through a resistance. The switch is then thrown right over to the other side, and the synchronizer switch is closed, and finally, when synchronism is reached, the transformer secondary switches are closed and the starting switch placed in its middle or no-contact position. Above the secondary switches are handwheels for adjusting the field excitation of the rotaries, and above these again are three ammeters for each rotary. Two of these in each case are connected to the secondaries of small transformers, whose primaries are in series with the slip rings; they, therefore, show the current flowing from each phase to the rotaries. The third ammeter is in the field circuit. These connections are seen in the upper part of Fig. 12, the lower part of which corresponds to the board, at which current is metered to the tramway circuits.

On the meter board there is a voltmeter and two ammeters to indicate the continuous current passing from each converter and its voltage. A time element cut-out is placed on each of the positives from the converters, and an instantaneous cut-out on the negatives. The four switches in connection with each converter enable it to be utilized as a shunt machine, or as a compound-wound machine, with an equalizing switch for paralleling. As agreed with the Wolverhampton Tramways Company, the current delivered to them is passed through three meters in series. A single meter might be liable to error; if there were two meters and they differed, it would be difficult to know which was the correct one; so three meters are used on the "odd-man-out" principle. Although not more than three meters are in circuit at a time, six are provided; one set of three reads from 0 to 400 amperes, and the other three from 0 up to 1,200 amperes. There are also two recording ammeters reading up to 400 and 1,200 amperes

to correspond with these, a recording voltmeter and a set of plugs for short-circuiting the meters and recorders which are not in use.

The rotary converters are rated at 250 kw each, and they run at 600 revolutions, the frequency being 50 cycles, as already stated. They are of the Westinghouse standard type, with a damping coil on each pole piece, and are compound-wound. Their continuous-current output is 400 amperes, at from 500 to 550 volts. As will have been gathered from the description of the switchboards and the diagram of connections, the regulation of the continuous-current voltage does not take place with the assistance of induction regulators or regulating turns on the secondaries of the transformers, but by a variation of the excitation. Altering the excitation varies the lag between the alternate-current voltage, and practically varies the transformation ratio of the step-down transformers, which are specially built to have a high inductance at light loads. A decrease in the strength of the field increases the lag of the alternate current behind the pressure, and the pressure is lowered owing to the increase in self-induction. Conversely an increase in the field increases the pressure, and in both cases the continuous-current voltage, of course, changes with the alternating voltage. As the converter fields are compound wound, this regulation is largely automatic, but there is provision to vary the resistance of the shunt-exciting circuit. Evidently it is not anticipated that this will be called into requisition much, however, for the field rheostat is on the rotary converter board, where no voltmeter is provided, and the only voltmeter is on the meter board on the other side of the room. The total variation in pressure which

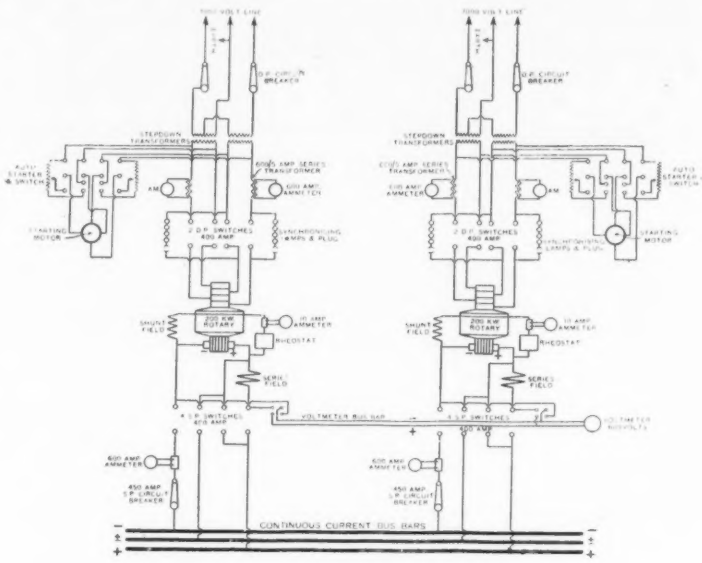


FIG. 12.—DIAGRAM OF CONNECTIONS OF ROTARY CONVERTER.

can be effected with the rotaries at the Bilston substation by varying the shunt excitation amounts to over 15 per cent.

From the meter board the current is led to the board of the Wolverhampton tramway. This board has four feeder panels, with cut-outs, ammeters and single-pole switches, the usual negative booster connections and the Board of Trade panel. A booster runs at 850 r. p. m., and can deal with 260 amperes and produce a pressure of 49 volts as a maximum. There is space in the first-floor of the substation for a battery, but none has been put in yet.

The Wolverhampton tramways is one of the offspring of the British Electric Traction Company. Its route, which was indicated in Fig. 1, is in all 10 miles in length, and is part single and part double track. The current is all taken from the Bilston substation, and is supplied to the line through the usual feeder pillars, placed at about one-half mile intervals. The line construction is chiefly with span wire suspension from side poles, but there is a certain amount of single-bracket pole construction as well. In this connection, it is interesting to remark that the Board of Trade has recently limited the length of bracket arms to 16 feet, so that span wires will now be used on new work instead of those top-heavy-looking poles with extraordinarily long brackets, which are an eye-sore in some towns. On the Wolverhampton and district lines, the telephone wires are in some parts overhead, being placed on the poles.

The three insulators on the right carry the telephone wires, which are supported by a clip fixed to the pole.

Following are the rates which has been fixed by the Midland Corporation. All the supply, except to the tramway company, is by two-phase alternating current, at 200-volts pressure. For lighting, the consumer can choose between a flat rate of 4½d. per kw-hour, or 6d. per kw-hour for the first 100 hours of maximum demand per quarter, plus 3d. for additional units. For power, the flat rate is 1½d. per kw-hour, with discounts to large consumers; and the "Wright" system tariff is 3d. per kw-hour up to 78 hours of maximum demand per quarter, and after that 0.825d. per kw-hour.

Recent Electrochemical Developments.

BY CLINTON PAUL TOWNSEND.

ETHER FROM ACETYLENE.

A direct method for the synthesis of ether from acetylene, proposed by Joseph W. Harris, is of especial interest. While there are a variety of chemical methods for effecting this transformation, they are in general indirect, alcohol being formed as an intermediate product; it is quite possible that in Mr. Harris's method alcohol forms as an intermediate step of the reaction, but the synthesis is, for practical purposes, direct.

Acetylene is introduced into strong sulphuric acid solution in the cathode compartment of an electrolytic cell, the anode of which is enclosed in a porous cup; the gas reacts with the liberated hydrogen, yielding a mixture of ethylene (C_2H_4) and ethane (C_2H_6), the conditions of the reaction being such as to restrict as far as possible the production of the latter gas.

This ethylene, formed in strong sulphuric solution, passes at once into ether, the controlling feature of the reaction being the presence of relatively small percentages of water—not to exceed 35 per cent.—in the acid. At lower acid concentrations the formation of alcohol is noted. The reactions considered most probable by Mr. Harris are as follows:

1. $C_2H_2 + H_2 = C_2H_4$,
2. $C_2H_4 + H_2SO_4 = C_2H_5OSO_2OH$,
3. $2C_2H_5OSO_2OH + H_2O = (C_2H_5)_2O + H_2SO_4$.

In other words (1) acetylene by union with hydrogen passes into ethylene; (2) ethylene unites with sulphuric acid to form ethyl-sulphuric acid; and (3) ethyl-sulphuric acid in the presence of water breaks up with formation of ether and regeneration of the acid electrolyte.

Inasmuch as certain of the known carbides and carbide mixtures react with water with formation of ethylene, it would be interesting to determine whether they would yield some ether by decomposition with strong sulphuric acid.

ELECTRICAL REDUCTION OF IRON ORES.

A known method for the reduction of iron ores consists in coating the fragments of a dividend ore with a carbonaceous reducing agent, coking the carbonaceous matter in place, and thereafter reducing to sponge iron. This method, with the additional step of fusing the sponge by the passage through it, or through the molten iron, of an electric current, is now patented to Mr. Marcus Ruthenberg, of Philadelphia. As the apparatus is described, the electric current is passed between lateral terminals through a pool of molten metal in the bottom of the furnace, the developed heat serving to fuse the reduced iron in the zone immediately over the molten meal; the reduction of the iron ore and the coking of the carbonaceous coating, take place in successively higher zones of the furnace, the latter operation being conducted on a hearth over which the waste gases play.

It is scarcely yet born in upon inventors that the practicability of the reduction of iron ores by electrically-developed heat is doubtful at best; and that if success ever crowns the persistent efforts which are being made along this line it will come as a result of such careful study of the conditions for economical energy transformation as has been given to no converter of energy save only the electric lamp. A common conception of the electric furnace of the resistance type seems to be two electrodes and a short-circuit, the usual assumption being that electricity will turn with completeness and economy into heat, provided only it be brought within furnace walls.

October Meeting of the American Institute of Electrical Engineers.

Illumination and photometry were the subjects on the programme of the October meeting of the American Institute of Electrical Engineers, represented by three papers, as follows: "An Integrating Photometer for Glow Lamps and Sources of Like Intensity," by Prof. Charles P. Matthews; "Distributed Lighting," by Mr. Douglass Burnett; and "The Commercial Accuracy of Photometrical Measurements," by Dr. Clayton H. Sharp.

By request of President Scott, Mr. T. C. Martin detailed the results secured in founding the John Fritz medal, in which the Institute had co-operated with the three other national engineering societies, Messrs. Calvin W. Rice, R. W. Pope, Wm. Maver, Jr., and Martin having represented the Institute on the general committee since its formation early in the year. The medal is to be awarded annually on the recommendation of a board, constituted of four members from each body, for achievement in the industrial arts and sciences. The Institute nominees for the board are the three latest past presidents, Messrs. Hering, Steinmetz and Kennelly, and the present president, Mr. Scott.

The John Fritz Banquet, which is to be held on Friday, October 31st, in the ballroom of the Waldorf-Astoria, will be an occasion of more than usual importance, as it is to signalize not only the eightieth birthday of Mr. John Fritz, of Bethlehem, Pa., the oldest steelmaster in the country, but the foundation by the four national engineering societies of the Fritz gold medal. Towards the foundation of this medal about $6,000 have been contributed by 484 members of the American Society of Civil Engineers, American Society of Mechanical Engineers, the American Institute of Mining Engineers, and the American Institute of Electrical Engineers, as well as some of the most distinguished steelmakers and engineers in England, Germany, France, Belgium, Scotland, Austria, Wales and Luxembourg. The medal is a design of Mr. Victor D. Brenner, and at the dinner a large bronze reproduction of it is to be given to Mr. Fritz and the cast then broken. A number of interesting and novel features will be presented at the dinner, and the speakers include some of the most notable engineering authorities in the world. The venerable Abram S. Hewitt has promised to attend; Admiral Melville is to speak for the Navy, and Gen. Eugene Griffin for the Army. Each of the four engineering societies is to be represented by its president, and to be responded for by a leading official or past president. Prof. Elihu Thomson will respond for the Electricals. The list of 500 guests includes every name of importance in the engineering professions or the arts connected with steel production, and in distinction compares with that of the "Captains of Industry" at the famous breakfast given to Prince Henry. A number of congratulatory messages have been received from all parts of the world, attesting the universal interest in this first co-operative movement of the American engineering societies, and the foundation of a medal which compares with the celebrated Bessemer one, as a reward to inventive genius and industrial leadership. Out-of-town members of the Institute in the city last week on Institute business were: C. P. Matthews, Ralph D. Mershon, F. O. Blackwell, C. C. Chesney, P. M. Lincoln, Prof. H. J. Ryan, Harold W. Buck, J. S. Peck, Prof. E. B. Rosa, P. G. Gossler, F. A. C. Perrine, C. J. H. Woodbury.

The paper by Prof. Matthews, which will be reprinted in a following issue, described a type of photometer which may be used; 1. as a simple photometer for any unidirectional measurements, such as occur in standardizations, ratings and candle-power distributions; 2. as an integrating instrument for the direct determination of mean horizontal, mean spherical, mean hemispherical or mean zonular candle-power; and 3, as an integrating instrument for the direct determination of the spherical reduction factor—that is, the ratio of mean spherical to mean horizontal candle-power.

The instrument consists of 12 pairs of mirrors, arranged concentrically to the lamp to be tested, each pair of mirrors being capable of a certain amount of radial movement for purposes of initial adjustment, and the plane of the mirrors being rotatable in azimuth. With this arrangement the mean spherical candle-power may be determined with the ease and celerity of the ordinary photometric measurement.

The paper of Dr. Sharp discussed the accuracy of photometrical measurements, that is, whether they stand on equal or nearly equal footings with other electro-technical measurements. Photometrical measurements were divided into three general classes, corresponding to similar classes in electro-technical measurements in general. For these classes, different degrees of accuracy are to be expected. The first class includes those measurements in which the primary standard or unit of luminous intensity is used to calibrate secondary standards of the same. This is similar to the calibration of secondary standards of resistance from a mercury ohm, and like the latter, the results are involved in the uncertainty connected with the production of the primary standard.

The second class comprises the calibration of working secondary standards by reference to the original secondary standards. This is the class of work which can be carried out to the highest degree of accuracy. The third class includes commercial measurements of sources of light by reference to working secondary standards, and corresponds to ordinary electrical testing where direct reading instruments are used and no effort is made toward great refinement. Speed is an important factor in this kind of work.

The paper then gives the results of tests made to determine the accuracy attainable in these three classes of work, full details and data of the tests being included in the paper.

In testing the accuracy of work of the first class, starting out, that is, from a primary standard, two Hefner amylacetate lamps and one Harcourt 10-cp pentane lamp were repeatedly compared with invariable incandescent lamp standards.

The mean difference between the lamps tested was but 1.2 per cent. in a series of 14 measurements made on 10 different days. The mean deviation of the values uncorrected for humidity from the mean of all was 1.7 per cent. for both lamps, while the corrected values differed only 1.1 per cent. and 1.0 per cent. on the average. The greatest deviation of a single measurement from the mean of all was but 4.8 per cent., but this occurred when the indications of the lamp disagreed by 5.2 per cent., and in any practical case this measurement would have to be rejected. If the mean indication of the pair of lamps is taken as representing a measurement, the mean deviation was 1.0 per cent., and the maximum 2.5 per cent.

In the measurements coming under the second class—the copying of incandescent standards—ten lamps were tested. The greatest mean deviation from the mean for any lamp is 0.07 per cent. in voltage, which corresponds to about 0.05 cp. The final results may be taken as certainly correct within narrower limits than this value. The closeness with which photometrical measurements can be made under these conditions is such as to task the capabilities of the best direct reading voltmeter. The voltmeter actually used in making these was a Weston laboratory standard. Certainly, for commercial purposes, copies of photometric standards need not be made any more accurately than this table shows that it is possible to make them.

As showing what may be and is done in strictly commercial measurements, ten lamps were measured at marked volts on four different photometers by four different photometer teams, under strictly commercial conditions. Each photometer was turning out some 500 lamps a day, measured just as these ten were. Each value given represented a single photometer setting.

The greatest deviation of a single measurement from the mean of the four was 2.5 per cent. The mean of the maximum deviations is but 0.4 per cent. It is particularly important to note that the results obtained by different operators on different photometers are in substantial agreement. The deviations of the candle-power of the individual lamps from 16 are to be ascribed to the fact that these lamps were marked to integral voltages.

When photometrical measurements are made on sources of light, such as the electric arc, the limits of allowable error must be considerably extended. The difficulties of arc-light photometry have often been ascribed to the difference in color which exists between the light of the arc and that of the comparison source. This is undoubtedly a real and a serious difficulty, but it is not an unsurmountable one. The great trouble in arc-light photometry has been that photometrists have been trying to ascribe a constant value to a varying quantity, namely, the luminous intensity of the arc in a given direction. Just as soon as a rational endeavor is made to measure some moderately constant luminous element of the arc, such as its total luminous flux or its mean spherical intensity, good, consistent results can be obtained, as the experiments of Professor Matthews have amply proved.

The conclusions of Dr. Sharp were as follows: 1. There are primary standards of luminous intensity, which, whatever may be their shortcomings from the point of view of the physicist, are sufficiently accurate for commercial purposes. 2. These standards can

be copied with as high a degree of accuracy as is desired. 3. Rapid photometrical measurements can be made with all the accuracy required for commercial purposes. 4. In the case in which photometrical measurements are in the worst repute, namely, in the photometry of the arc, the chief fault lies with the varying nature of the quantity which it is sought to measure rather than with available methods of measuring the same.

The paper by Mr. Burnet dealt with illumination at surfaces as contrasted with intensity of sources of light. It is shown to be possible in some measure to calculate the distribution of lighting along an illuminated surface, though the problem becomes further complicated when a second reflecting surface is introduced, and it may be at present considered impracticable to determine with any fair degree of accuracy the actual illumination in a room.

It seems, however, quite possible actually to measure this lighting effect. In several instances such curves of illumination have been plotted, but are usually based upon the assumption that there is no reflection or diffusion. In others, the mistake has been made of plotting the candle-power of the light incident upon the surface, with the result of exaggerating the apparent lighting effect. A fundamental law in this connection is that illumination from independent sources may be arithmetically added to determine resultant illumination. An error which has always been made is in connection with the plotting of the space intensity curves of incandescent arc, Nernst and other lamps. The impression they convey would much more nearly accord with what actually occurs if the curve showed—not the intensity of light in the various directions—but the lines along which the lighting is equal at any point. Such curves may be called "isophotals," and while they are of the same general shape as intensity curves, their dimensions are as the square root of the radii. The tendency of enclosing an arc, for instance, either in the interior gas globe, or more particularly in the outer diffusing globe, is to make such an isophotal curve approach more nearly a circle, which effect is further enhanced by the diffusion from a neighboring ceiling; thus tending towards the desired result of a flat curve, indicating uniform illumination.

Arc lamps for the lighting of country roads should be such as throw their lighting downward; whereas in the lighting of city streets, lined with buildings, such lamps should be used as will throw an amount of light on the walls for diffusion purposes as will not be objectionable to the occupants.

A number of photometers for determining the intensity of sources o flight have been devised, while few instruments, notably those of Weber and of Houston and Kennelly, for the measurement of illumination on a surface have been described; and in each of these the lighting was not measured directly, but was adjusted by means of screens or by means of the weakening of visual power, and then compared with a standard amount of illumination.

The Bunsen, the Lummer-Brodhun and other standard photometers operate with varying and indeterminate amounts of lighting on the surfaces to be compared; any one of them is in essence a luminometer rather than a photometer, since the candle-power is deduced by the application of the mathematical formula instead of measured or compared directly.

Mr. Burnett has devised an instrument arranged so as to expose a standard white surface to the ordinary lighting of a room, the amount of which is not varied. The position of a small incandescent lamp in reference to a similar and adjoining surface is, however, adjusted in order to secure within commercial limits an equal illumination, the position of this standard lamp being indicated on a graduated scale in terms not of distance but directly in terms of the number of luxes. Other observers have stated that the use of small incandescent lamps is quite permissible for such purposes for several hundred consecutive observations. The only precaution necessary in the use of such an instrument would be to shield the eyes from light other than that reflected from the two standard surfaces, and to shield each respectively from the other source of light.

It may be of interest at some future date to plot the space candle-power curves from a standard open arc without enclosing globe, the space candle-power curves of an enclosed lamp of the same watt consumption with the diffusing globes used in practice, the isophotals from the latter lamp, the theoretical illumination from the open arc along a horizontal surface without diffusion and the actual illumination curves from the lamp with the enclosing and diffusing globes in a room under normal operating conditions.

In addition to the case cited there have been but few instances where the amount of illumination on a surface has been measured or calculated, notable among which may be mentioned a test of the lighting of the streets of Paris.

Our methods of expressing illumination have been in terms of the number of standard lamps, such as those of 16-cp, 50 watts per hundred or thousand square feet of surface. Bell has expressed an opinion that 5-cp per square inch is a maximum for interior lighting; Cohn has given 10 meter candles as the hygienic minimum, and 50 meter candles as the value of daylight, and Wybauw has given 15 to 25 meter candles as necessary to fluent reading, or one meter candle for street lighting. Possibly practical requirements may hereafter be more clearly specified by the assistance of some such instrument as suggested in the paper.

Messrs. Scott, Nichols, Upton, Marks, Smith, Rosa, Ryan, Rice, Hammer, Stratton, Howell and Marshall took part in the discussion that followed the papers. Prof. Nichols said that the mean spherical candle-power should always be used to which to refer measurements, even if another unit is found convenient for some practical purposes. He spoke highly of the papers of Messrs. Burnett and Sharp as contributions to the study of illumination. He outlined the method he has employed in connection with room photometry; the floor is divided into squares of one meter, and a small white card placed in each division and the illumination thereon determined by means of a photometer. The same card is then placed on a movable stand, and the illumination explored at a distance of one meter above the floor, two meters, etc., the method thus being analogous to the exploration of a magnetic field. Prof. Nichols said that all of the newer sources of light are too bright for the eye, and that illumination considered as a fine art will consist in placing lamps so that the source of light will not be visible.

Mr. F. R. Upton dwelt upon the importance of illumination as opposed to the intensity of the source. He called attention to the fact that no inconsiderable amount of illumination in the vicinity of cities and towns well supplied with respect to exterior lighting is reflected from the clouds; this reflection under favorable circumstances being sufficient to light up buildings and the landscape considerably. Prof. Marks reviewed the work of committees of the American Institute of Electrical Engineers and National Electric Light Association, with respect to measurement of light. One committee of the former favored mean spherical candle-power, and another total flux expressed in terms of the lumen; and the committee of the National Electric Light Association reported strongly in favor of the mean spherical candle-power. He said that the total flux is an excellent term in which to express light. He thought that the fact that the Matthews' arrangement enabled the spherical reduction factor to be easily obtained was a strong recommendation for it, particularly in view of the fact that some large electric light companies now insist upon such factor being specified in the purchase of lamps. Mr. John W. Howell said that the Lamp Testing Bureau had tried the Matthews' instrument, and it worked out so well that the Bureau will use it for making spherical measurements. Mr. Marshall added that the Edison Lamp Works would use the Matthews' photometer, and Mr. F. B. Smith and Prof. Rosa also commended it. Mr. Calvin W. Rice considered that a better substandard should be used than the incandescent lamp. He said that in a written communication on the papers read, which Mr. A. J. Wurts asked him to submit, the room photometer referred to by Prof. Nichols is advocated. Mr. W. J. Hammer suggested the use of selenium cells in room photometry. Prof. Sharp expressed the opinion that the incandescent lamp is a satisfactory substandard if it is intelligently used.

Pittsburg Meeting of the A. I. E. E.

At a meeting of the local members of the American Institute of Electrical Engineers, of Pittsburg, held Monday evening, October 13th, a committee, consisting of P. M. Lincoln, Professor S. M. Kintner, Calvin W. Rice, J. S. Peck and F. B. Erwin, was appointed to call a second meeting, provide a progamme therefore, and to propose a plan for a permanent organization. The committee decided to accept the invitation of the Electric Club, an organization made up chiefly of engineering apprentices, to hold the next meeting in their hall in Wilkinsburg, on Thursday evening, November 6th. The members of the club were in turn invited to attend these meetings

and to take part in the discussions. As to programme, it was decided to take up for discussion the general subject of illumination suggested by the papers taken up at the general October Institute meeting.

Professor Kintner, of the Western University of Pennsylvania, is to give a resumé of the papers presented at the general meeting, and Mr. Scott will give a summary of the New York discussion. Mr. Wurts will be asked to discuss the general topic of the evening—illumination. Although no definite arrangements have yet been made, it is expected to have talk also on the Nernst-Bremmer flame-arc lamp, and on the Cooper-Hewitt lamp, by gentlemen who are more or less familiar with these subjects. Acetylene lighting and indirect electric lighting will also receive a share of attention. It is also proposed to illustrate the remarks by exhibitions of the lamps themselves. A Nernst lamp, a Bremmer arc-lamp, a Cooper-Hewitt lamp, and an acetylene gas light will be exhibited in the hall during the evening. The stated communications will be restricted to not over ten minutes each, and the subject will then be thrown open to general discussion.

As to permanent organization, the committee will recommend that an executive committee of five, consisting of a chairman, a secretary and three other members, be elected at the meeting of November 6th, to take full charge of this local section, including the calling of meetings, the preparation of papers, etc.

Hot Water Heating From a Central Station.*

By E. H. McKnight.

Owners of electric light plants have long desired to increase the earning capacities of their properties without appreciable additional expense. This has lead to an investigation of the utilization of exhaust steam as a means of heating buildings. Wherever this business has been added to an electric light plant it has proven its salvation, especially where competition has been keen and profits small.

The purpose of this paper is to give a general idea of the equipment and operation of such an enterprise.

Details of Construction.—Pumps and condensers, or heaters, an expansion tank and a catch-all constitute the equipment of the station. Large duplex pumps are used to circulate the water about the system. They are operated at a low pressure during moderate weather, but in extreme cold weather the pressure is increased.

An open tank of sufficient capacity is placed at an elevated position, and used as an expansion tank for the system. Any good condenser or open heater into which the exhaust steam from the engines is turned can be used. The condensation formed is conducted back to the boiler by means of a small automatic pump, furnishing a quantity of heated water free from impurities, the oil having been extracted by means of the catch-all. The water for the heating system is pumped under pressure into the condensers or heaters, and becomes heated, passing out of the condensers or heaters and continuing its travel about the circuit. The condenser should be of ample size to heat sufficient water to care for the amount of radiation installed. A continuous and uninterrupted service during the heating season is assured by having all station equipment in duplicate.

The Mains.—Upon leaving the station, from eight to twelve-inch pipe is used, this depending upon the capacity of the system; the size of same is reduced at intervals until the end of the line is reached. The two pipe system has many advantages, in my opinion, over a single-pipe system; one pipe being used for the supply, and the other for the return. With this arrangement water is brought directly into each building from the heating apparatus, not having passed through any other building.

The insulation of the mains is a matter which necessitates much care and attention. The material which has been found to be the most efficient and inexpensive consists of hemlock boxes, built with double air-tight compartments in which the mains are laid; the space remaining about the pipes being well filled with process shavings or mineral wool. The outside of the boxing is protected by a prepared building paper.

Where this kind of insulation has been used the loss of heat on the line amounts to not more than 15 to 20 degrees; that is to say, when water is sent out at 180 degrees, it will return to the plant at 160 degrees. Thus when this water is raised from 160 degrees to 180 degrees, it is ready to send out again. Care should also be taken in anchoring the mains and providing for expansion.

Cost of Operation.—The expense of operating the heating plant under ordinary conditions is not great, the principal expense being in the amount of live steam used to operate the circulating pumps, which at no time is any great amount, the total for the entire heating season being a comparatively small item. No extra labor is needed at the plant, since what little attention the heating plant may require can be given by the same force of men heretofore employed at the electric light plant.

In order to fully realize upon the investment at the earliest possible time, it is most desirable to secure the services of one who is thoroughly conversant with the details of the business and familiar with the method of figuring for the purpose of making contracts for the heating of every available building located upon the pipe line.

As soon as the capacity of the pipe line has been reached, this additional expense can be dispensed with.

Method of Figuring.—The rules used are the same as those given by the highest authorities on the subject of heating, and are the same as those which have been in general use for a number of years.

In determining the amount of heat a given building will consume, measurements are taken of the cubic contents of each room, it being assumed that the atmospher of a room changes once and must be reheated. The square feet of exposed glass surface is also measured, the loss of heat through one square foot of glass being 75 times as much as the heat consumed by one cubic foot of air. Next the square feet of exposed wall surface is taken, it being estimated that ten square feet of wall surface, in the average well-built house, will lose as much heat as one square foot of glass surface.

By this means we arrive at the total number of feet of radiating surface to heat a given building, allowing one square foot of radiating surface for every hundred feet of cubic contents or its equivalent. An erroneous impression has gone forth to the effect that the heat is charged for according to the number of feet of radiation used, whether this be much or little; but in reality the cost per year is governed by the amount of heat the building will consume, and is not based entirely upon the number of feet of radiation contained in it. It is a well-established fact that hot water as a heating medium is far superior to all other known methods of heating. Among the numerous advantages to be had from this particular method is the fact that during the fall and spring months when a moderate amount of heat is desired, this need can be supplied by circulating the water at a low degree of temperature.

The heat from such a system is supplied to the consumer 24 hours a day, and every day upon which heat is needed; the service being continuous and uninterrupted, it gives the consumer the least concern. A crowning feature of this system of heating is obtained by the use of heat regulators, one or more being placed in each building. This insures an even, regular temperature through the house at all times.

* A paper read at the Eighth Annual Meeting of the Ohio Electric Light Association.

New Telephone Patents.

The wave of prosperity must certainly have at last reached the telephone inventors, for instead of the one or two patents, per issue, bearing upon the subject of telephony, which was the general run a few months since; now a Patent Office issue containing four, five and even more telephone patents is no rare occurrence. Of course the number of patents issued, while of some general interest, carries little weight unless the patents themselves are valuable, but as a rule the large issue contain no more than the usual proportion of doubtful material. Of the patents issued this week, one is for a receiver, one for an antiseptic mouthpiece, one for a switchboard plug and two for a very novel type of inclosures for telephones; as to the value of which the reader is referred to the following descriptions:

The improvement in receivers, for which a patent has been granted to Willard M. Miner, consists in the replacing of the large sound opening in the middle of the cap by a number of very small openings. These small openings are small drillings, grouped near the center of the cap, and sufficient in size and number to allow of the proper issuance of the sound waves from the air space in front of the diaphragm. The primary object of the invention is the prevention of injury to the diaphragm by any instrument in the hands of a maliciously-inclined or curious person, or from accidental injury from the prongs of the hook switch. The value of the invention is doubtful as far as protection from sharp instruments is concerned,

for a needle is sufficiently large, when properly applied, to ruin a diaphragm. On the other hand, as a protection from the hook switch, the new cap will undoubtedly be a success. As to the effect of the change from a single to a multiple opening upon transmission, some doubt arises. Mr. Miner states, "A very important function performed by the small perforations is their equalizing and refining effect upon sound waves, caused by the vibration of the diaphragm. While waves of ordinary amplitude pass through without encountering obstruction, those of greater amplitude, which would cause unpleasantly loud sounds in the ear, are impeded to a certain extent, so as to greatly lessen their unpleasant effects." The reason for this paradoxical action of the small holes is not quite evident at first sight, but if such action does actually occur, the future of the new receiver should be assured.

A good idea of the new antiseptic mouthpiece may be well obtained from Fig. 1, which shows a sectional view. The holder for the antiseptic consists of a metallic box, pierced at its center by a perforated, cloth-covered tube. This box also has an opening at one side for the admission of the antiseptic, and is normally closed by a screw. A metallic case is provided for the antiseptic, containing box so arranged that the ordinary transmitter mouthpiece may be screwed into the center of one of its faces, while the other carries a threaded projection which screws into the face of the transmitter.

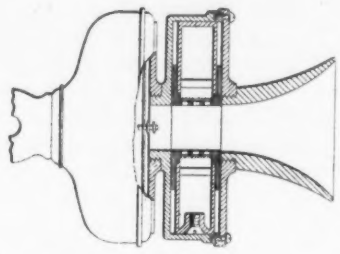


FIG. 1.—BROWN MOUTHPIECE FOR TRANSMITTERS.

By this means the porous tube of the box becomes a mere extension of the sound passage of the regular transmitter mouthpiece. The patent for this device is granted to Mr. Y. W. Brown, of Philadelphia.

Patent No. 711,556, issued to Henry P. Clausen, and assigned by him to the American Electric Telephone Company, claims one thing which is new, and one thing which is old. The former is an attachment to a switchboard plug, whereby the usual fibrous rubber protecting sleeve may be held in position without the use of screws. A small metallic stud carried on the end of a flat spring is so mounted upon the body of the plug that when the protecting sleeve is slipped into position, the stud is forced by the spring into an opening in the sleeve provided to receive it. To remove the sleeve from the plug, it is only necessary to press the stud through the sleeve against the pressure of the spring and then to slip the sleeve off the plug. The stud and spring are shown in Fig. 2. To any one who has struggled with the small screw usually employed to hold protecting sleeves in place, this part of the invention needs no recommendation. The second part of Mr. Clausen's invention claims novelty for the provision of an insulated collar about the body of the plug, in order

FIG. 2.—CLAUSEN SWITCHBOARD PLUG.

to insure that no contact shall occur between the body of the plug and the test ring of the jack, in those switchboard systems where an individual test circuit is provided. As all plugs for the so-called branch terminal switchboards of the American Bell Company for the last seven or eight years have been similarly equipped, the novelty is not apparent.

Fig. 3 shows two views of one of the inclosures for telephones, invented by A. Y. Parke, of Boston. This inclosure is constructed very much like an awning, and is shown at the right in the raised position. On desiring to use the telephone, the subscriber drops the awning over his head and shoulders, to screen himself and the telephone from extraneous sounds. A light is provided in the roof of the inclosure, as shown. This apparatus reminds one forcibly of the habits of the ostrich, in trying to shield his whole body by covering his head. Mr. Parke's second type of inclosure is built upon more liberal lines, consisting of a curtain mounted upon a flexible steel frame in such a manner that the user may readily draw the curtain completely around himself and the telephone, thus forming a small cloth booth. The top of this inclosure is a sheet

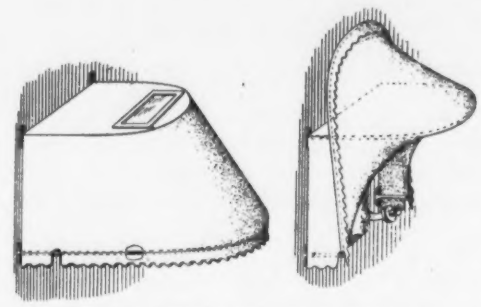


FIG. 3.—PARKE TELEPHONE ENCLOSURE.

of glass, while the bottom of the curtain extends nearly to the floor. After reflecting upon the rise of temperature in the ordinary telephone booth, with its fairly large enclosed volume during a call, the value of the above inclosure as accessories to a Turkish bath must at once suggest itself.

Right of Property in Quotations Sustained.

At Chicago, on October 28, an important principle of law was established when Judges Jenkins, Grosscup, Baker and Bunn, of the United States Court of Appeals, handed down an opinion to the effect that the Western Union Telegraph Company has a right of property in the news which it gathers, and that such right does not cease when the news is published on the tickers rented to its patrons. In laying down this new principle, the Court of Appeals affirms two decisions of the lower court, and forever enjoins the National Telegraph News Company, the Illinois Commission Company and other defendants from using the quotations in question.

The court says: "The business of appellee is that of a carrier of information. The gist of its service to the patron is that by such carriage the patron acquires knowledge of the matter communicated earlier than those not thus served. The ticker, with its printed tape, is an implement or means only to this commercial end, which the patron, or the patron's patron, may utilize to the end intended, but may not appropriate to some end not intended, especially if such appropriation result in injury to or total destruction of the service. In short, the law being clearly inadequate to that purpose, equity should see to it that the one who is served and the one who serves each gets what the engagement between them calls for, and that neither to the injury of the other, shall appropriate more.

"The immediate business of appellee, brought to our attention, may not arouse any great solicitude. It relates to the gathering and distributing of news, not looked on, perhaps, in all quarters as essential to the public welfare, but the questions raised are of much wider significance. These involve among others that modern enterprise—one of the distinctive achievements of our day—which, combining the genius and the accumulations of men with the forces of electricity, combs the earth surface each day for what the day has brought forth, that whatever befalls the sons of men shall come, almost instantaneously, into the consciousness of mankind. By such agencies as these the world is made to face itself unceasingly in the glass, and is put to those tests that bring increasing helpfulness and beauty into the heart of our race.

"Is service like this to be outlawed? Is the enterprise of the great news agencies or the independent enterprise of the great newspapers or the great telegraph and cable lines to be denied appeal to the courts against the inroads of the parasite, for no other reason than that the law fashioned hitherto to fit the relations of authors and the public, cannot be made to fit the relation of the public and this dissimilar class of servants? Are we to fail our plain duty for mere lack of precedent? We choose rather to make precedent—one from which is eliminated as immaterial the law grown up around authorship—and we see no better way to start this precedent upon a career than by affirming the order appealed from.

CURRENT NEWS AND NOTES.

THE MESSENGER BOY STAMP.—The messenger boys are to have official recognition by the Government. In a few weeks the delivery stamp will have a new design of a boy riding a wheel instead of the familiar messenger rushing with a letter in his hand. The size and shape of the stamp will be kept, but the design is regarded as much more characteristic and artistic. Instead of dark blue, the new stamp will be light blue or carmine.

WIRELESS TELEGRAPHY IN THE NAVY.—A telegram from Annapolis, Md., of October 23, says: Successful experiments were made to-day between the Naval Academy and the auxiliary cruiser "Prairie" with the Slaby-Arco system of wireless telegraph. Signals were exchanged between the "Prairie," 70 miles down the Potomac, and the station here. To-day's experiments are said to have given entire satisfaction to the naval experts conducting the tests. Representatives of the company assist in the experiments, which will be continued until the extreme limits of the system are determined.

HIGH LIVING.—On October 25, a company of half a hundred Philadelphians had the novel experience of eating luncheon at the top of a brick smokestack, 275 feet high. Only one of the guests declined to go up. He was a politician. The smokestack, which is one of the largest of its kind in this country, has just been built for the Southern Electric Light and Power Company, at Christian Street and Schuylkill. The inside diameter of the stack at the top is 18 feet. About five feet below the rim a platform was built, and on this a long table laden with good things to eat was placed. There was chicken salad, and there were sandwiches which had gone up in an unprecedented way, and coffee, and olives, and such things. "High balls" were also favored as an appropriate drink.

MILLIONS OF TRANSFERS.—Some interesting facts are noted about trolley transfers in New York: The Metropolitan Street Railway Company during the year of 1901 gave out 176,000,000 transfers, and this year, on account of the further extension of the transfer system, the company expects that the number will reach 200,000,000. The transfer system was inaugurated in 1884, and during the first year the company distributed 156,000 of the free tickets. Each year the number has increased, till it has reached the figures now recorded. Giving out this number of transfers has cost the company an enormous sum of money in printing and paper. Over 10,000 tons of paper were used for the transfers of last year, and as the dates are changed each day, the cost of printing was also very large.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION.—Mr. C. M. Goddard, the secretary, informs us that the annual meeting of the electrical committee of the Association will be held at the New York Board Rooms, 32 Nassau Street, on Tuesday, December 9th at 10 A. M., continuing two, and possibly three days. Members of the committee and others have been requested to forward any suggestions as to changes in the National Code, to his office, in Boston, not later than November 25th, when the communications will be put in type and distributed to members for consideration previous to the meeting. It is the custom at these meetings to first consider such matters as have been sent in in advance and are contained in the printed report, after which, if any time remains, those present may present suggestions from the floor.

SUSQUEHANNA POWER.—It is stated that the engineers who, in the interest of the Continental Trust Company, of Baltimore, have been investigating the possibility of using the Susquehanna River have reported favorably. Plans for the work have been completed, with the exception of certain details of hydraulic engineering. It is proposed to furnish light and power to Baltimore and many towns in the northern part of the State, between York and the river, and also Elkton, Wilmington, Del., and other points east of the river. The Continental Trust Company, which has an option on the purchase of the United Electric and Power Company, of Baltimore, until November 15, it is reported, will soon close the deal, involving nearly $1,000,000. A new company probably will be formed to take in this and other lighting and power companies as part of the Susquehanna power plan.

THE PACIFIC CABLE.—A special dispatch from Victoria, B. C., of October 20, says: Civil Engineer Dearlove, who superintended the laying of the Pacific cable from New Zealand to Fanning Island, has arrived here from London. He goes to Bamfield Creek, a landing station of the cable on Vancouver Island, where he will for 30 days subject the cable line to a severe test before accepting it from the Telegraph Construction and Maintenance Company. He expects from the perfection of the cable that a speed of 100 letters a minute will be attained. Dearlove transmitters, an invention of his own, will be used on the longest line in the world. It is expected the last section from Fanning to Suva will be completed by November 5, by Anglia. Mr. Dearlove does not believe that it is an assured fact, as stated, that the cable from Hawaii to this line is to be constructed. The matter is being considered.

TROLLEY AND LIGHTING CENSUS.—Director Merriam, of the permanent census office, has appointed 75 clerks to visit the large cities and work up the data on street railways and electric lighting. The importance of electric traction, power and lighting will be recognized by a special census volume giving all the statistics of electrical work, including the details of corporate interests, capitalization, rate of installation, and the per cent. of increase of traffic and lighting. Two special schedules, one for trolleys, etc., and one for electric lighting, have been prepared. Mr. T. C. Martin, who was the special expert agent for the government in the last census, for electrical manufacturing, has been appointed again, to assist the office in its present inquiry, which was ordered by Congress last March. Street railways were included in the census of 1890, but no report has ever been made on the growth of electric light and power companies.

THE NEW WHITE HOUSE at Washington will have practically no gas fixtures. Electricity will reign supreme. It has long been evident that the use of electricity in the type of chandeliers suitable for gas or oil lighting was an absurdity, when electricity only was to be employed. The change permits much more tasteful and effective methods. The so-called "sunburst," used in some of the rooms of the temporary office building, has been put into two or three of the rooms of the White House, but as a rule its lighting appliances are similar to the candelabra designs of the period of 1800, and have been worked out with special reference to the present methods of lighting. The results are reported to be exceedingly satisfactory. The telephone arrangements of the new building are as complete as modern appliances can make them. There is a private system for the rooms of the house, and through the switchboard a connection with the outside world, local and long-distance. It will be possible, from any room of the house, to talk with the gardener or the steward or the butler; heretofore it has been necessary to send a messenger. President Roosevelt is nothing if not up to date.

THE LONDON RAILWAY DEAL.—A special despatch from London states that the motion to recommit the bill granting a franchise to the Morgan group for the construction of the Piccadilly, City and Northeast London Railway was withdrawn on the night of October 29 in the House of Commons after an interesting debate. It was made clear, however, that the settlement of the House was overwhelmingly in favor of the Morgan scheme, and it was only because it involved a grave violation of ordinary parliamentary procedure that the proposed action was not taken. The result of the present situation is simply that the Morgan scheme is postponed for the one year necessary to regain its parliamentary status. There is little doubt that all the necessary powers will then be granted by Parliament. The debate evoked unprecedentedly plain speaking in the House, where the participants, while differing on other things, agreed that the Robinson and White interests, which promoted the West London scheme, obtained parliamentary sanction and then sold it behind the back of their agreement, and had been guilty of the most discreditable sharp practice. Mr. Thomas Ashton, who brought the business before the House, said he doubted if ever before such a dirty transaction had been done by parties who had come before Parliament. J. S. Morgan & Co., he added, had been the victims of a dishonorable transaction, and Parliament had been tricked.

PROGRESS IN CUBA.—A cable dispatch from Havana says: The Senate and House of Representatives has adjourned until the first Monday in November. The House voted a concession to the National Telephone Company for 50 years. The company will have the exclusive right to establish a telephone service in Cuba. The details of the concession will be discussed at the next session. The company is an American concern.

TECHNOLEXICON.—We have several times noted that the German Society of Engineers has undertaken the publication of a polyglot technical dictionary, and that it solicits the co-operation of engineers throughout the world to render the work of the highest possible value. Dr. Alfred Müller, 150 Nasau Street, New York, is authorized by the Society to arrange in this country for collaboration in the work, and application may be made to him for further information on the subject. Mr. Müller will supply collaborators with notes books especially arranged for their use.

WIRELESS FOR CABLE-SHIPS.—A cable dispatch from London, of October 21, says: The Eastern Telegraph Company has equipped its cable-ships with a new system of wireless telegraphy, designed by J. E. Maskelyne, Jr., for the company. He purposes to utilize the ships in an auxiliary telegraph service for inter-island communication or any other short stretches, where tides and rocks unduly shorten the life of a cable. Mr. Maskelyne's system makes use of a new form of coherer, dispensing with metal filings. He claims that the action is much more delicate and reliable.

THE LONDON TUBES.—As to the recent Yerkes victory, noted last week, a cable dispatch, of October 23, says: The contention made by counsel for Charles T. Yerkes before the House of Commons' Railroad Committee, on Tuesday, that the bill providing for the construction of a Piccadilly and City road must be withdrawn. as the Morgans' "tube" scheme had no legal status through having been presented to Parliament as part of the London United plan, which became non-existent that day through the withdrawal of its bill, was upheld by the committee to-day. The chairman, Sir Lewis McIver, announced that the committee was unable to proceed with the consideration of the bill. It is learned that the Morgans do not propose to abandon their underground projects. In spite of the decision of the committee, they will have a bill introduced in 1903, giving facilities similar to those of the scheme just quashed by the defection of the London United, control of which was purchased by Speyer Brothers, who are financing Charles T. Yerkes's plans. It is extremely doubtful, however, whether Parliament will grant the concessions desired.

AN ENGLISH POWER SCHEME.—A plan is on foot for supplying electricity and gas for Cheshire and North Staffordshire, with a proposed capital of £1,500,000. Three generating stations, each with engines of 2,000 hp, are to be built. The district covered is mapped out in the form of three circles. Within each circle a particular generating station will operate in the supply of electricity and power gas, but all will be connected. Two stations will be built in Cheshire and one in Staffordshire. Seven acres have been procured for a generating station within a mile of Frodsham. This station is near the railway, and on the banks of the canal. Thirteen acres will be obtained at Sutton, near Macclesfield, and the third site is one of 11½ acres at Stone. The Frodsham station will supply Runcorn, Chester, Sandbach, Nantwich, Tarporley, Middlewich, Winsford, Northwich, Knutsford, Altrincham, Sale, etc. The other stations in like manner will supply the towns and villages in the locality. It will be possible to supply trolleys with current, and it is not improbable that the projected Macclesfield to Warrington electric tramway will be supplied by the syndicate with the necessary power.

POWER AT THE SOO.—At Sault Ste Marie, Mich., on October 25, water was turned into the new power canal of the Consolidated Lake Superior Company, and Miss Helen Clergue, sister of Francis H. Clergue, organizer and general manager of the company, turned a jeweled switch that started the wheels in the big power house. Miss Clergue started the machinery and set the wheels in the power house whirling for the first time. The first current generated was used to run one of the company's new electric street cars. A civic and military parade marched through the streets during the morning, the parade exceeding anything ever seen in Upper Michigan. Over 10,000 men were in line. In the afternoon an industrial parade was given, which showed the different products of the Clergue institutions in the various stages from raw material to finished product. At night the three days' celebration ended with a banquet in the armory. The opening of the new water-power canal on the Michigan side of the St. Mary's River marks the completion of an engineering work of great magnitude, which has been in progress for four years, and which has been accomplished at a cost of about $4,000,000. A very full account appeared in these pages recently, with illustrations.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—This body continues its rapid growth, and Secretary Cahoon reports the following additions to the list of membership since the end of September. He also states that many companies are contributing liberally toward the fund for further tests of arc lamps: Evanston (Ill.) Electric Illuminating Company; Hoosick Falls (N. Y.) Electric Company; Crookston (Minn.) Water Works, Power and Light Company; Citizens' Electric Company, Eureka Springs, Ark.; Portsmouth (Ohio) Street Railway and Light Company; Meridian (Miss.) Light and Railway Company; Morrison County Electric Light, Heat and Power Company, Little Falls, Minn.; Westport (Conn.) Water and Electric Company; Zanesville (O.) Electric Light Company; Faraday Heat, Power and Light Company, Morton, Pa.; United Gas and Electric Company, Dover, N. H.; Monett (Mo.) Electric Light, Power and Ice Company; Branford (Conn.) Lighting and Water Company; Robert E. Strahorn, Sumpter, Ore.; Havre De Grace (Md.) Electric Company; Citizens' Electric Company, Eaton Rapids, Mich.; Taylorville (Ill.) Electric Company; The Washington (Pa.) Electric Light and Power Company; The Larimer Light and Power Company, Fort Collins, Colo.; Janesville (Wis.) Electric Company; Waynesburg (Pa.) Electric Light and Power Company; Antigo (Wis.) Electric Light Plant; Key West (Fla.) Electric Company; The Canadian Electric Light Company, Quebec, Ont.; Ashland (Ore.) Electric Light and Power Company; Big Fork Electric Power and Light Company, Kalispell, Mont.; Streator (Ill.) Gas and Light Company; Cheyenne (Wyo.) Light, Fuel and Power Company; North Shore Electric Company, Hoquiam, Wash.; Madison (Ind.) Lighting Company; Lewiston (Pa.) Electric Light Company; Dayton (Wash.) Electric Light and Power Company; The Electric Company, Connellsville, Pa.; Citizens' Electric Illuminating Company, Pittston, Pa.; Erie (Pa.) Company; Consolidated Gas and Electric Company, Batavia, N. Y.; Georgetown (S. C.) Electric Company; Pipestone (Minn.) Light, Heat and Power Company; Newport (N. H.) Electric Light Company; Pine Bluff (Ark.) Light and Water Company; Roanoke (Va.) Railway and Electric Company.

LETTER TO THE EDITORS.

Central Station Electrical Engineering.

To the Editors of Electrical World and Engineer:

Sirs.—The reports which frequently appear in your columns, of the proceedings of the minor electrical associations disclose a certain condition not at all, it appears to the writer, creditable to the business acumen of the owners and managers of the smaller central stations of this country. Judging from the experiences sometimes related at these meetings, or implied in the remarks of speakers, and the inquiries for technical information as to proposed changes or extensions of plants, it would appear that many of our central stations are presided over in a slip-shod manner from the engineering standpoint, and supposed improvements mostly made by blindly following what some one else has done, and with little or no regard to the specific conditions of a particular case. In other words, with this class the professional engineer has no standing, and electrical engineering seems to be regarded as a "frill." Doubtless in some cases the engineer's fee is the deciding factor, but we venture to say that in ninety-nine cases out of a hundred the cost of "investigation" by the non-technical owner or manager, and the mistakes inevitable in their selection and installation of plant would almost invariably many times cover such a fee.

It is said that a very large proportion of the central stations of this

country are non-paying ventures, and this is most probably attributable to the condition above noted. While the smaller stations could not afford to have on their staff a professed engineer, yet the rapid changes in the art and the engineering questions that frequently arise would appear to demand occasional expert advice; but too often in this respect the electrical plant is not differentiated from the case of a planing or flour mill. In recent years many hundreds of non-paying stations have been bought up by capitalists, and placed upon a profitable basis, the stations under their original ownership having languished through parsimony or ignorance in not securing engineering guidance—the profit that had been latent thus being realized only to be lost to the communities. If each central station were inspected once or twice a year by a consulting engineer, and changes or additions to plant only undertaken on his advice, we venture to say that the aggregate additional profit to the central station industry incident to such a system would many times cover the aggregate of engineers' fees.

CHICAGO, ILL. CHAS. L. BATES.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Deri System of Compensated Direct-Current Machines.—EICHBERG.—A very long and profusely illustrated paper read before the German Association of Electrical Engineers. On his compensated direct-current dynamos and motors, Deri uses no pole system with distinct poles, as in ordinary direct-current machines, but a distributed stator winding, like in the primary of an induction motor. Moreover, he has two different windings distributed over the stator, one is the real field exciting winding, while the other, called the compensation winding, is for the purpose of compensating for the armature field in order to insure perfect commutation. In a similar way as in a two-phase machine, the exciting and the compensating winding are placed on the stator; for the exciting winding one-third to at the most one-half the number of ampere turns of the compensation winding are required. The adjoining diagram represents a four-pole stator winding with 48 slots. The shunt winding

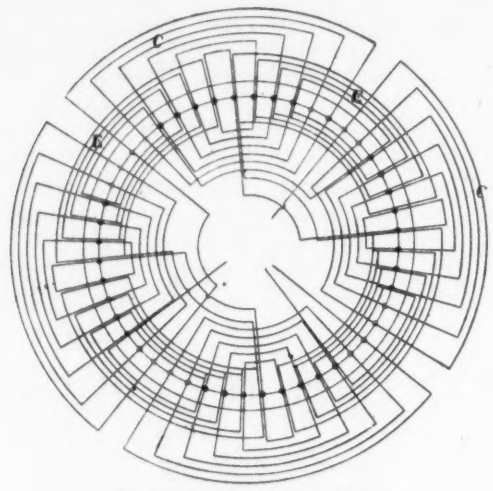


DIAGRAM OF CONNECTIONS

(excitation winding) *E* comprises 8 slots in each pole field. The compensation winding, *C*, passes through all the slots in order to get as uniform a field as possible, due to the compensation winding and the armature winding. The essential point of Deri's compensation is that the number of ampere turns of the compensation winding is not equal to the number of ampere turns of the armature, but greater by a certain amount, so that the difference of compensation ampere turns and armature ampere turns produces a field which he calls the commutation field, and which is always proportional to the armature current, which also flows through the compensation winding, being in series with the armature. By a proper choice of number of turns of the compensation winding, it is always possible to get the proper commutation field once for all for any load or overload. If after the construction of the machine is finished, the compensation winding is found to have too many turns, it is easy to correct the error by shunting the compensation winding. A displacement of the brushes has the opposite effect when the machine is used as dynamo or as motor. When the exciting field is decreased in the generator it is increased in the motor, and when it it increased in the generator, it is decreased in the motor. The latter case would be fatal, as the motor would run up to a higher speed and take in more current, the field would further decrease, etc. By using a high saturation in the stator core, it is, however, possible to obtain a steady and safe operation not only at the theoretical neutral line, but also with a small displacement of the brushes. Many details are discussed, and results of tests of machines are given. Among other things he remarks that the complete compensation of the armature reaction and the removal of the difficulties of the commutation, enables one to make the air-gap as small as is allowed by mechanical considerations. Nor is it necessary to use the high induction in the rotor teeth and the high number of ampere windings of the magnets, required in machines of ordinary construction. In several machines which he has designed, and which have given very satisfactory results, he has decreased the ratio of magnet ampere windings to armature windings to one-third. The less amount of magnet copper wire and the uniform distribution of the compensation winding along the stator result in smaller outside dimensions.—*Elek. Zeit.*, September 11.

Commutators and Slip-Rings.—HELLMUND.—An article in which he discusses the mechanical treatment of commutators and slip-rings. The principal point is generally to diminish the wear and tear as much as possible. To hold the energy loss, due to the Joulean heat, within proper limits, it is necessary that the resistance of the brushes should be small; against this requirement acts the fact that in machines with bad commutation a better commutation can be obtained by means of a high specific brush resistance. Finally the heating effect should remain within proper limits, so that the commutator insulation is not affected. He first discusses metal brushes, and gives the results of some tests, showing the influence of lubricating upon the brush resistance. The results show that the influence of lubricating may be quite different for different conditions of the sliding surface, and probably depends also on the material; moreover, lubricating does not reduce the resistance in any instance; it appears that under normal circumstances there is no increase of the ohmic losses, or, if there is any, it is balanced by the considerable decrease of the friction losses, so that in any case where a small brush resistance is wanted, no trouble may be feared from lubricating, although the layer of oil should not be too thick. In such machines, in which a higher brush resistance is wanted in the interest of good commutation, special lubricants are suitable; he obtained good results by using a lubricant, consisting mainly of paraffine and tallow. At present, of course, carbon brushes are generally used, where a high transition resistance is wanted. With carbon brushes no lubricants should be used. Although he found that the use of the lubricant of paraffine and tallow, mentioned above, sometimes decreases sparking, he thinks that the same results may be obtained by using a sort of carbon of higher specific resistance. In general the pressure with which the brushes are pressed against the commutator should be as small as possible, as Dettmar has shown that the increase of the friction losses with increased pressure overbalances the advantages of decreased ohmic loss. To press the brushes tightly on the commutator may be advantageous only in such cases in which the machine is exposed to strong vibrations with consequent danger of sparking, due to the vibrations.—*Elek. Zeit.*, September 11.

REFERENCE.

Alternator Design.—DENHAM.—A paper, read before the Cape Town local section of the British Institute of Electrical Engineers,

in which he gives "some notes on alternator design." He discusses the general principles of the construction of alternators and emphasizes the superiority of polyphase over single-phase working. There is also a separate editorial on this subject.—Lond. *Elec.*, September 26.

POWER.

Cost of Electric Power Transmission.—ADAMS.—An article in which he discusses the three main factors concerned in the cost of electric power transmission, namely, the transformers, the pole line and the wire or conductors. The first cost of the transformers varies directly with the maximum rate of transmission, and is nearly independent of the voltage, the length of the transmission and the percentage of line loss. A pole line changes in first cost with the length of the transmission, but is nearly independent of the other factors. Line conductors, for a fixed maximum percentage of loss vary in first cost directly with the square of the length of the transmission and with the rate of the transmission; but their first cost decreases as the percentage of line loss increases and as the square of the voltage of transmission increases. Applications are made to numerical examples. The distance over which energy may be transmitted at a given rate, with a fixed percentage of loss and a constant weight of copper, increases directly with the voltage employed.—*Cassier's Mag.*, October.

Mine Hoist.—An illustrated description of an electrically-driven mine hoist, exhibited by Siemens & Halske at the Dusseldorf exhibition. It is designed to hoist 9,200 lbs. of coal at each lift, from a depth ultimately of 1,640 feet. A main shaft carries at its center the rope sheave and brake drum, at each side of which is located an electric motor of 1,400 maximum horse-power each. These motors may be connected in series or in parallel, and thus be worked at full or half speed, and in case of accident to one motor, work may be continued with the other. By various combinations (not described) of the storage battery and alterations of the field current, speeds of 2, 4, 5, 6, 8, 10, 12, 16 and 20 meters per second can be obtained without loss of energy, and practically any intermediate speed may be obtained with slight loss from the rheostats. Direct current of 500 volts is used.—*Am. Mach.*, October 9.

REFERENCES.

Electric Power.—SELBY-BIGGE.—The first parts of a paper, read before the Iron and Steel Institute at Dusseldorf, on the application of electric power in the iron and steel industries. He gives actual facts and figures from practice, on the saving obtained by the use of electric power, and a table of details concerning motors for various mechanical purposes.—Lond. *Elec. Rev.*, September 19, 26.

Control of Electric Motors in Factories.—WOODFIN.—An article discussing mechanical details of the construction of starting switches. Lond. *Elec. Rev.*, September 19.

Coupling of Machines.—EHNERT.—A brief illustrated article on the mechanical problems involved in the direct coupling of prime movers and dynamos.—*Zeit. f. Elek.*, September 28.

TRACTION.

Interurban Electric Railway Car Equipments.—POTTER.—An article in which he first points out the effect of curves on train resistance, and gives the speed at which cars can travel around curves with safety, which, he says, roughly in miles per hour is the square root of the radius of the curve in feet. Grades, provided the cars can coast at the bottom of the grade, do not materially affect the power consumption, but especially if trailers are hauled, they become of serious importance in determining the motor capacity, the gear ratio and the minimum weight on drivers. Under ordinary conditions of track, the coefficient of friction may be taken from 15 to 18 per cent. of the weight on drivers, and two miles per hour per second is a reasonable maximum for comfortable acceleration. The speed curve should be concaved at the beginning instead of being a straight line, to insure comfort to passengers, just as the braking curve is concave at the end. If the grades exceed 5 per cent., or if the acceleration exceeds 1¾ miles per hour per second, four motors will be found essential (with a four-axle car) for reliable service. Two motor equipments (for a four-axle car) will have a slightly higher efficiency, but four motors of the same total power rating will perform a faster schedule for the same temperature rise because the total radiating surface of four motors is greater. The writer recommends a truck-wheel base, for high-speed work, of 7 feet rather than the more common standard of 6 feet, as this will provide room for 200-hp motors, large axles and an ample bolster, and special attention should be given to the method of wiring and installation of motors to see that no danger of fire results. The cables should preferably be carried in a non-inflammable conduit of asbestos compound rather than in metal ducts, as the former will not maintain an arc. All parts of the flooring of the car near the motor should be of asbestos compound. The writer then discusses the subject of fuses, car switches and the trolley wheel, which latter has shown a surprising capacity for high-speed work. A single trolley wheel can be depended upon to carry 200 amperes at 60 miles per hour, 400 amperes at 30 miles per hour, and 800 amperes at 10 miles per hour. For heavy high-speed service the third-rail is more desirable than the trolley.—*St. R'y Jour.*, October 4, and *Int. Ed.*, October.

Detroit.—An article on overhead construction and electric power distribution in Detroit. On the Flint division an inverted rotary of 250 kw is installed in the direct-current power station. Current is transmitted at 15,000 volts over two circuits of aluminum wire as far as 48 km. The rotaries in the substations on this division are started as direct-current motors from the trolley line, and when run to as high a speed as possible are thrown into the three-phase circuit. The other lines are fed by direct-current and boosters. The city system is supplied from two stations adjoining each other, and a diagram shows the method of connecting the bus-bars together. The switchboard of these two stations have three sets of bus-bars, allowing three different voltages, viz., 625, 575 and 550. Full details are given also of the circuit breakers, feeders, etc.—*St. R'y Jour.*, October 4, and *Int. Ed.*, October.

Track Maintenance.—An illustrated article on track construction and maintenance in Detroit. The cost of maintenance on interurban track falls between $7.50 per mile per month in winter and $12 in summer. All of the rail is 60 to 70 lbs. T, and the joints seem to be in very good condition. Some trouble has been experienced with rails 60 feet in length from drawing apart on grades, but in other respects they are considered more desirable than shorter rails. Illustrations also show an electric shoveler, for shoveling gravel on construction work; it was made in the shops of the company, and saves the wages of six men. Another illustration is of a semaphore signal, for switches, which shows "clear" only when the switch is entirely closed. At the steam railroad crossings, interlocking signals and derailing switches are used. Details are given concerning the track construction.—*St. R'y Jour.*, October 4, and *Int. Ed.*, October.

REFERENCES.

Motor Power and Rolling Stock at Detroit.—FARMER.—A description in detail of the stations of the traction company of Detroit, of which there are six. The two largest are adjoining each other, and their bus-bars can be connected. The heaviest interurban car of the company weighs about 33 tons, loaded. All express and freight matter is carried on special cars. The construction of the rolling stock is described in detail. The interurban cars are usually heated with hot water, and the city cars by hot air or electric heaters. The illustrated trolley wheels, used in the city, are self-oiling. Views are also shown of a machine for rewinding old field coil wires. When the field coil becomes defective, the insulation is burned off in the fire and then the machine illustrated rewinds it. In the latest machine, instead of burning off the insulation, it is cut off by the machine which is fitted with a pulley with a corrugated steel face.—*St. R'y Jour.*, October 4, and *Int. Ed.*, October.

Surface Contact Systems.—LORDEREAU; DOTTER.—Replies to critical remarks made by Paul in a recent article.—*L'Ind. Elec.*, September 25.

Berlin.—PERKINS.—An illustrated article on the latest developments of the Berlin elevated and underground railway.—*Elec. Rev.*, October 11.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

German Central Station.—A description of the new station of Erlangen. The three-wire system with 440 volts between the outers is used. The capacity of the station is at present 420 hp. The dynamos are driven by gas engines. There is a storage battery of 272 cells, giving 648 amp.-hours if discharged in three hours. The results of the tests of the gas engines are given.—*Zeit. f. Elek.*, September 14.

REFERENCE.

Single-Phase Plant.—An illustrated article on the single-phase pumping plant of the Hammersmith Vestry, England, where a single-

phase traveling crane is also installed.—Lond. *Elec. Rev.*, September 26.

Electro-Physics and Magnetism.

Sparking Distances in Oils.—Jona.—An account of tests of a large number of various oils with respect to their "dielectric strength." The charges were derived from an alternating-current transformer yielding voltage as high as 160,000. The oils differ greatly in their insulating powers, but the curves indicating the relation between voltage and maximum sparking distance all tend to become straight lines at voltages higher than 80,000. Natural olive oil shows the lowest insulating power. Benzol and fused paraffin are at the other extreme, and of these, benzol shows only a very slight increase of sparking distance for the higher voltages. It begins at 44 cm., and rises to only 47 cm. at a voltage of 160,000. The sparking distances in air show a very much greater increase with voltage than those in any liquid, but they also tend to a straight curve at the higher voltages. All dessiccated oils show a smaller change of sparking distances with voltage than the corresponding oils do in their ordinary state. Toluol, xylol and solution of colophony in xylol have nearly the same insulating power as benzol, but the modern vaseline oils used for transformers closely approach them. Benzol is, in any case, too dangerous on account of its inflammability.—*Atti. Ass. Elet. It.*, No. 4, 1902; abstracted in Lond. *Elec.*, October 10.

Electric Spark Gaps.—Lecher.—A description of a set of experiments, in which he electrified the whole secondary of an induction coil from an influence machine, and then worked it as usual. He found that the brushes usually seen on the positive electrode of an induction coil, when no spark can pass, are enormously increased when the whole is positively electrified, whereas they disappear when the electrification is negative. The results are probably due to the fact that the charge of the influence machine eliminates from the air of the spark-gap one or the other kind of electrons.—*Ann. d. Phys.*, No. 10, 1902; abstracted in Lond. *Elec.*, October 10.

Luminosity and the Kinetic Theory.—Butler-Burke.—An abstract of a British Association paper on "luminosity and the kinetic theory," in which he points out that the phenomena of luminosity are accompanied by or dependent upon the formation of large molecular aggregates, which act as centers of intense molecular force; and that the luminosity results from the bombardment of these by the free corpuscles in the luminous body, which in virtue of these powerful centers of force acquire a great velocity under their attraction and produce collisions of considerable violence.—Lond. *Elec.*, September 26.

Luminescence of Wires in a Vacuum.—Borgmann.—An account of experiments with two wires in a vacuum tube, mounted parallel to the axis and connected to an induction coil. A narrow strip of tin-foil was stuck along the tube outside. He describes the various phenomena produced by connecting one or both of the wires with the induction coil and exhausting to various degrees of vacuum. When both wires are connected with the positive pole, with a spark gap in parallel with the coil, and the strip of tin-foil not earthed, both wires show portions of luminous lenses at right angles to the axis of the tube; at smaller pressures, the lenses are changed into cylindrical sheaths of violet light surrounding the wires. When both wires are connected to the negative pole, and the tin-foil is earthed, two luminous surfaces appear between the tin-foil and each wire, while at lower pressures there are longitudinal sheaths of light interrupted by dark rings.—*Phys. Zeit.*, September 15; abstracted in Lond. *Elec.*, October 10.

Longitudinal Magnetization of Nickel.—Williams.—An account of an experimental investigation of the fact that the length of a nickel wire is diminished, while its electrical resistance is increased by longitudinal magnetization. When these effects are represented in curves showing the change of length, or resistance, as a function of the magnetizing field, it is found that the two curves bear a very striking resemblance to each other. He has continued the investigations of the relation between these two effects, the results being given in tables and diagrams.—*Phil. Mag.*, October.

Elasticity and Magnetism.—Honda, Shimizu, and Kusakabe.—An account of an experimental investigation of the change of the modulus of elasticity of ferromagnetic substances, by magnetization. It has been generally admitted that the effect is small, and former experimenters found that magnetization increases slightly the modulus of elasticity in iron and nickel, and that the change increases with the magnetizing force. They have experimented with soft iron, steel, wolfram steel, nickel and cobalt. The results are given in tables and diagrams. The results obtained for iron, steel and nickel are far greater than those given by former experimenters. The modulus of elasticity of nickel decreases in weak fields.—*Phil. Mag.*, October.

REFERENCE.

Vacuum Tube Discharge.—Skinner.—An account of a theoretical and experimental investigation of the conditions controlling the drop of potential at the electrodes in vacuum-tube discharge. He discusses the variation of the anode drop with the potential gradient in the positive column, the anti-cathode effects, the effect of tin-foil coating on the tube surrounding the cathode, the effect of a magnetic field on the electric drop, and the effect of a magnetic field on the anode drop.—*Phil. Mag.*, October.

Electro-Chemistry and Batteries.

Lead Refining.—Ulke.—An article on the Betts electrolytic process of refining lead bullion, which is said to have a low working cost and a high efficiency, and which is worked at a plant of about 10 tons daily capacity. The process is based on the solubility of lead in an acid solution of lead fluosilicate, from which very pure lead is said to be deposited with impure anodes at a very low cost. The fall in potential between tanks is only 0.2 volt. A current density of 14 amperes has given the most satisfactory results. According to the inventor, each ton of lead refined, including casting of anodes, requires the burning of 210 lbs. of fuel. The silver slimes obtained, averaging about 8,000 ozs. of gold and silver per ton, are now treated at the Seattle Smelting and Refining Works.—*Eng. & Mining Jour.*, October 11.

Chlorates.—J. B. C. Kershaw.—A second article on the electrolytic manufacture of chlorates. He discusses the Corbin cell and the Franchot & Gibbs cell, and makes some remarks on the efficiency of the various processes. He gives an estimate of the cost of chlorate of potash, made in a 3,000-hp hydroelectric plant, producing 1,600 metric tons of chlorate; the cost per pound of chlorate is 4.7 cents. He gives a summary of numerous laboratory investigations bearing on the theory of chlorate cell and various practical results which have been obtained. Foerster and Mueller state that the best efficiency is obtained when an electrolyte is used containing sodium chromate and free hydrochloric acid, in conjunction with a spongy platinum electrode. Under these conditions two-thirds of the chloride present in the cell can be converted into chlorate with a current efficiency averaging over 94 per cent.—*Elec. Rev.*, October 11.

Trilbelhorn Storage Battery.—An illustrated description of this lead cell, made in Switzerland. It is said to be used in factories, hotels and central stations. Its characteristic feature is the arrangement of the cells, which are in the form of conical leaden dishes, one above the other. The upper side of each dish is positive, the lower negative. The active material is keyed in peculiarly formed furrows on both sides of the dishes. The charging voltage increases to 2.75, and the discharge voltage decreases to 1.85 at slow discharge, and to 1.72 at fast discharge. The amp.-hour efficiency is in the average 90 to 92 per cent., the watt-hour efficiency 68 to 70 per cent.—*Elek. Neu. Anz.*, October 1.

REFERENCES.

Free Ions.—Olsen.—An account of an experimental investigation into the existence of free ions in aqueous solutions of electrolytes. His experiments are based on the following considerations: It is believed that an electrostatic charge attracts and repels the unlike and like charged ions, respectively; and as it is the ions which, in giving up their charge, produce a current, then if these ions can be guided by an electrostatic charge, we should get a current with electrodes indifferent to the solution, and be able to detect it with a sufficiently delicate galvanometer.—*Am. Jour. Sc.*, October.

Copper Refining.—Dujour.—An illustrated popular article on copper refining.—*La Nature*, September 20.

Units, Measurements and Instruments.

Alternating-Current Voltage Selector.—Heinke.—An illustrated description of an instrument, which is to be used for calibrating alternating-current instruments and for alternating-current tests of any kind, in which an easy variation of the voltage is desirable. The instrument is essentially a transformer, which, however, has not two, but a large number of windings of suitably selected number of turns and cross sections; they are connected like the resistances in a resistance box, which are varied by putting in or taking out plugs; in the

present case the voltage can be varied in sufficiently small steps and in an economic way. This is especially suitable for calibrating ammeters or other apparatus with large currents and low voltage.—*Elek. Zeit.*, October 2.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Light Telephony.—RUHMER.—An illustrated account of some recent experiments with "light telephony." He has succeeded in getting good communication over a distance of 7 km (4¼ miles). As has been noticed before in the Digest, the principle is as follows: at the transmitting end the sounds spoken into microphone generate variations of the current, which are superposed on the direct current from a storage battery, feeding an arc lamp. This gives the phenomenon of the sparking arc, and the light intensity of the arc lamp follows the vibrations. The vibrating light rays are made parallel by a parabolic searchlight reflector, and transmitted to the receiving station, where they fall upon a reflector in the optical axis of which there is a cylindrical selenium cell; this cell is connected in series with a battery and two telephones. If the selenium cell is sensitive enough the transmitted sounds are reproduced. It is necessary to use such a current at the transmitting station for feeding the arc lamp, that the illumination of the selenium cell is at the point of its maximum sensitiveness. He uses 4 to 5 amperes for transmission over 1 to 2 km, 8 to 10 amperes for 3 to 4 km and 12 to 16 amperes for 5 to 7 km; the greater the distance, the more light is needed at the transmitting station, in order to keep the illumination of the selenium cell at the most favorable point. He finds that the relatively short wave lengths of the spectrum are the most active in the phenomenon of the "sparking light." The construction of the selenium cell is the principal point, and he promises a description of his cells in the near future. He says his cells are at least as good as the one used by Simon, which has a resistance of 533,000 ohms, and is reduced to 26,000 ohms with an illumination of 400 lux. In the author's cell, thin layers are used. After having been illuminated, the original resistance, which corresponds to darkness, is reproduced within a few minutes. His experiments were made on the Wannsee, and are said to have given very satisfactory results. He thinks light telephony has a practical future for use in the army and navy.—*Elek. Zeit.*, September 25.

MISCELLANEOUS.

Physiological Effects of Röntgen Rays.—OUDIN.—A full account of the pathology and treatment of the skin disease radio-dermatitis, which is the consequence of excessive exposure of the skin to Röntgen or Becquerel rays. It is a painful and troublesome malady, which may last for 18 months, and is difficult to cure. As regards treatment, nothing has yet been found capable of stopping the development of the disease. The electric effluvium and red light appear to accelerate the course of heating, and it is supposed that red light would, to a certain extent, counteract the effects of Röntgen rays, as they somewhat resemble the effects of ultra-violet light. Besides this acute radio-dermatitis, which is practically confined to over-exposed patients, there is a "chronic radio-dermatitis," which attacks the operators and affects more especially the fingers. He uses fencing gloves, containing a padding of very fine brass wire, to protect his hands.—*Arch. d' Elec. Med.*, September; abstracted in Lond. *Elec.*, October 10.

New Books.

DIE GLEICHSTROMMASCHINE. Theorie, Konstruktion, Berechnung, Untersuchung und Arbeitsweise Derselben. By E. Arnold. Berlin: Julius Springer. 555 pages, 421 illustrations. Price, 16 marks.

This work is in character a classic, and constitutes by far the most thorough and able discussion of the modern direct-current dynamo that the reviewer has seen. With characteristic painstaking, the author reduces every feature of dynamo theory to its simplest aspect and considers each feature first alone and then in its relation to other features. In contrast to the frequently-encountered method of requiring the reader to supply missing links in an exposition, Prof. Arnold's explanations are in many instances, perhaps, unnecessarily exhaustive, but in every instance complete and lucid. In common with other technical writers, however, he goes to the trouble of filling many pages with rudimentary material that is superfluous to anyone capable of understanding the main parts of the book.

The first engineering information reached by the reader is on the theory of armature windings, which is treated very elaborately. Following this is a discussion of potential equalizing cross-connections for multipolar armatures, which is given the same elaborate treatment.

Chapter VI is devoted to potential differences between neighboring armature coils side by side and between adjacent commutator segments, with various types of winding; Chapter VII, to ring windings with parallel series and mixed connections; Chapter VIII, to drum armatures with similar windings; Chapter IX, to the disc winding and the Desroziers and Fritsche disc armatures; Chapter X, to open-circuit armatures; Chapter XI (which might as well have been omitted), to the three types of field winding series, shunt and compound; Chapter XII, also superfluous, to a elementary comparison of the dynamo and motor; Chapter XIII is a short description of different types of field magnets.

Chapter XIV, on the calculation of the magnetization curve of a dynamo, is more academic than practical. The treatment of the problem is beautiful, but it is doubtful if any designer outside of Germany ever goes through the appalling task of calculating air-gap excitation with allowances for flux paths into the slot edges of armature teeth and the plane end surface of the core. Field magnet leakage also forms part of the problem, and receives the same exhaustive treatment that is accorded air-gap excitation.

Chapters XV to XXI constitute the most valuable portion of the book, and contain a superb analysis of armature reaction, commutation, air-gap flux distribution, magnet pole construction, and the relations of all these factors to each other. It is impracticable to do justice in a book review to these chapters; they are simply a masterpiece. Chapter XXI concludes with a discussion of the compensating windings of Sayers, Fischer-Hinnen, Ryan and others. The remaining chapters are devoted to Characteristic Curves; Copper, Iron, Commutator and Mechanical Losses; the heating of field magnet coils and armatures, and their radiating surfaces.

ELECTRIC INCANDESCENT LIGHTING. By Edwin J. Houston, Ph. D., and A. E. Kennelly, Sc. D. Second Edition, Enlarged. New York: Electrical World and Engineer. 508 pages, 161 illustrations. Price, $1.00.

Four chapters have been added to the second edition of this work, in which are considered 240-volt lamps, Nernst lamps, the vacuum tube lighting, photometry of incandescent lamps, and incandescent lighting for railroad trains. The chapter on the Nernst lamp gives the theory of that lamp, and the Cooper-Hewitt lamp is described in the chapter on vacuum tube lighting. In the chapter on the photometry of the incandescent lamp, the principles are explained and brief directions for testing given.

NATURLEHRE. By Dr. Alois Lanner. Wien: Jos. Roth'schen Verlagsbuchhandlung. 377 pages, 377 illustrations.

This modern work on physics is intended for use by the upper classes in the gymnasia in Germany, and follows more or less closely the lines laid down in the recommendations of the German Imperial Bureau of Education about two years ago. As at that part of their course the students have not yet taken up the calculus or gone far into trigonometry, the former is not used at all in the book, although the latter is briefly mentioned under "Astronomy." Algebra is liberally used where necessary and vectors are handled on an early page, but as a whole there is little of a mathematical character to be waded through.

Somewhat unusual from the viewpoint in this country is the inclusion of chapters on chemistry and "Cosmic Physics." The former is of a length of 30 pages, mostly closely printed, and its extremely simple character and the descriptions of the more important properties of the elements that it contains make it of undoubted value.

Even organic chemistry receives some mention, and while this is necessarily of the most elementary character it can by no means be considered out of place. Under "Cosmic Physics" are included astronomy, physical geography and meteorology, the former being particularly well handled under the circumstances.

The electrical section is thoroughly modernized, the Röntgen and Becquerel rays, wireless telegraphy and multiphase transmission of energy all finding place. We note a curious lapse in the chapter on electrical measuring apparatus in that while instruments of the solenoid, hot wire and dynamometer types are named, there is no mention of the D'Arsonval type that is now in almost universal use

for direct-current measurements in this country as well as abroad.

No specific forms of apparatus for the demonstration of physical actions and laws are given, all illustrations of this kind being elementary and often only diagrammatic. This is in many respects a good feature, as it avoids the confusion that often arises in the students' minds when the book apparatus and that of the lecture-room are of different appearance. The number of the illustrations is, however, great, in order that some idea of the devices may be had, even if, as is often the case, there is no apparatus of the type required in the lecture-room's collection.

BOOKS RECEIVED.

MATERIALS OF MACHINES. By Albert W. Smith. New York: John Wiley & Sons. 142 pages, 17 illustrations. Price, $1.00.

ELEMENTE DER ELEKTROTECHNIK. By Moriz Kohn. Leipzig und Wien: Franz Deuticke. 108 pages, 121 illustrations. Price, 2.50 marks.

MECHANICS-PROBLEMS. By Frank B. Sanborn. New York: Engineering News Publishing Company. 155 pages, 60 illustrations. Price, $1.50.

DIE WECHSELSTROMTECHNIK. Herausgegeben von E. Arnold. Berlin: Verlag von Julius Springer. 425 pages, 263 illustrations. Price, 12 marks.

ALTERNATING-CURRENT MACHINES. By Samuel Sheldon, Ph. D., and Hobart Mason, B. S. New York: D. Van Nostrand Company. 259 pages, 184 illustrations. Price, $2.50.

AUFGABEN AUS DER ELEKTROTECHNIK NEBST DERED LOSUNGEN. By Dr. Phil. E. Müllendorff. Berlin W: Verlag von Georg Siemens. 113 pages, 14 illustrations. Price, 2.50 marks.

DAS SELEN UND SEINE BEDEUTUNG FUR DIE ELEKTROTECHNIK. By Ernst Ruhmer. Berlin: Verlag der Administration der Fachzeitschrift Der Mechaniker. 57 pages, 49 illustrations. Price, 2.40 marks.

A GRAPHIC METHOD FOR SOLVING CERTAIN QUESTIONS IN ARITHMETIC OR ALGEBRRA. By George L. Vose. Second Edition. New York: D. Van Nostrand Company. 62 pages, 29 illustrations. Price, 50 cents.

THE ELECTRIC TELEPHONE. By Edwin J. Houston, Ph. D., and A. E. Kennelly, Sc. D. Second Edition, Enlarged. New York: Electrical World and Engineer. 453 pages, 152 illustrations. Price, $1.00.

GALVANIC BATTERIES, THEIR THEORY, CONSTRUCTION AND USE. Comprising Primary, Single and Double-Fluid Cells, Secondary and Gas Batteries. By S. R. Bottone. London: Whittaker & Co. 376 pages, 144 illustrations. Price, 5 shillings.

THE ELECTRO-PLATING AND ELECTRO-REFINING OF METALS. Being a New Edition of Alexander Watt's "Electro-Deposition." Revised and Largely Rewritten. By Arnold Philip. New York: D. Van Nostrand Company. 680 pages, 160 illustrations, 14 tables. Price, $4.50.

Electrical Testing Laboratory.

The Lamp Testing Bureau is a company incorporated under the laws of the State of New York, with headquarters at No. 14 Jay Street, New York City. This location, near the Hudson River, Broadway and Duane Street, is conveniently situated for the visits of electrical men in the down-town neighborhood. The company also operates a testing station at Harrison, New Jersey.

The original purpose of the bureau was the testing of incandescent lamps supplied by the Edison Lamp Works, at Harrison, to the Association of Edison Illuminating Companies, under specifications as to quality and life. The bureau had, therefore, originally but one testing laboratory at Harrison, with a photometer room and a lamp-life testing department. Since that time the company has inspected upwards of 25,000,000 of incandescent lamps, and has measured the candle-power and life history of over 125,000 sample lamps.

The success attending the operation of the bureau has caused the company to extend its field of operation beyond the Association of Edison Illuminating Companies, and to come before the general public for the testing not only of incandescent lamps, but of electrical apparatus, cables, supplies and electrical machinery generally.

The laboratory of the company is on the 6th, 7th and 8th floors of the building at No. 14 Jay Street. Each floor measures 90 feet x 23 feet. On the 8th floor are the offices, and also a general electrical laboratory, equipped with the requisite portable instruments as well as instruments and apparatus of precision. Among the latter may be mentioned an accurately-adjusted Wheatstone bridge of the Anthony pattern, wound with manganin wire; a Thomson double bridge by Wolff, of Berlin, for the measurement of low resistances and of the conductivity of specimens of wire; potentiometers by Leeds & Company, of Philadelphia, and by Wolff, with a complete outfit of standard cells and with the requisite chemicals and apparatus for the preparation of standard cells; a complete set of maganin resistances by Wolff, running from 0.0001 ohm to 100,000 ohms, which are used as standards of resistance, and, in connection with the potentiometer, for the accurate measurement of direct currents up to 2,000 amperes; the platinum dishes and sensitive balance required to make standardizations by the silver voltameter. For alternating-current measurements, besides a very complete set of portable and semi- portable voltmeters, ammeters and wattmeters, there is a Rowland electro-dynamometer, with shunt box, by which a great variety of A. C. work can be done, including much of which is entirely outside of the range of the ordinary instruments. Standard condensers, keys, secohmmeters, et cetera, are at hand for cable testing, determining coefficients of induction, capacity, etc. Alternating-current instruments are checked or standardized by reference to standardized direct-current instruments, using reactanceless transfer instruments. The standard photometer, which is equipped for making all kinds of photometric measurements, is also on this floor. The accessory apparatus for correcting measurements made with the Hefner amylacetate lamp and the 10-cp pentane lamp, taking account of atmospheric conditions, is also at hand.

On the 7th floor are 300 cells of accumulator, arranged in several batteries, and used for testing purposes. On this floor are also a small converter, which can be driven by storage battery current to furnish alternating current for making instrument checks, and vibration-free meter boards, with the necessary arrangement for making accurate tests, and complete laboratory investigations on recording electricity supply meters, using current from storage batteries. There is also suitable space for testing heavier apparatus.

On the 6th floor are the motor-dynamo, which supplies current to lamps on life test, working photometers for life-test measurements, and the racks on which lamps on life test are set up to burn. These racks are at present capable of holding and supplying 1,100 incandescent lamps. The various pressures required are supplied to these lamps from a special sectional transformer, the e. m. f. of which is controlled by an attendant constantly on duty. Any integral voltage can be steadily maintained between 100 and 150 volts. The finer adjustments of voltage on individual lamps are made by placing suitable resistances in series with them.

The routine of incandescent lamp testing as usually practiced by the bureau is as follows:

When lamps are purchased from a manufacturer in large quantities, under the supervision of the bureau, an inspector is sent by the bureau to the lamp factory, and the lamps are there examined for physical defects. A number of sample lamps are selected at random from each barrel, and these lamps are tested in respect to accuracy of rating, their candle-power and watts per candle being measured. From each accepted barrel of lamps, the sample lamp is selected which most nearly represents the average qualities of the group. The test lamps thus selected are sent to the bureau in Jay Street, New York, are carefully photometered and are set up to burn at exactly their proper respective pressures on the life-testing rack. Their performance is carefully noted at the specified constant voltage from day to day, frequent photometer measurements being made to ascertain their behavior as to candle-power at different periods of life. As soon as a lamp falls to 80 per cent. of its normal candle-power, its life test is ended. The blackening of the bulb, the discoloration of the filament, the maintenance of the vacuum and other characteristic phenomena are all recorded, so that the reports of the bureau upon the lamps shipped by the factory are not only much more complete and much more nearly accurate than those which the manufacturer or purchaser could attempt to make himself, but by reason of the system and routine, the cost of testing is much less than that which the purchasers could individually effect.

The experience of the past seven years has shown the great commercial value of these systematic tests to manufacturers and purchasers of lamps. The charge for lamp testing of this character is based upon the nature of the test. A manufacturer or purchaser sending only a few lamps is charged considerably more per lamp

tested than if a large number of lamps is included in the test. Where the tests are made for the joint interest of the manufacturer and purchaser, it has been the custom in the past for the cost of the bureau's test to be divided between them. In all cases a full report is made to the party sending the lamps for test, and the party is allowed access at any time during the progress of the test to the lamps tested, as well as to the records and tests of the bureau upon those lamps; but information on such tests is strictly withheld from all other parties, and no manufacturer can have access to the test of any lamps save his own, without the mutual consent of the parties interested. When a party sends to the bureau lamps purchased in the open market, the lamps are designated by definite numbers, and the party is notified of the results pertaining to the lamps having those numbers, so as to prevent unauthorized statements being made under the apparent authority of the bureau, in regard to the quality of lamps made by the various competing manufacturers.

The facilities of the bureau are now placed at the service of the general public, and it is prepared to receive for test any kind of electrical apparatus. It is believed that the special facilities which are at hand for promptly making reliable and authoritative tests and checks of voltmeters, ammeters, wattmeters and recording meters, will be of especial convenience to the public. This general testing work will not conflict in any way with the work projected by the National Bureau of Standards, in Washington, since that institution will probably require to issue fundamental standards, and standards of reference of a higher grade of accuracy than that ordinarily needed in commercial work. On the contrary, it is expected that the work which the Lamp Testing Bureau intends to perform for the electrical public will aid and supplement the standardizing work of the Government Bureau, at Washington.

The Lamp Testing Bureau will also undertake the commercial testing of motors, dynamos and other electrical machinery of moderate size. If the machinery or apparatus is of such a character that it cannot well be transported to the laboratory for test, the bureau is prepared to send competent experts to the required locality to make the test needed. Such tests of apparatus, subterranean cables and machinery in general can be made promptly on demand.

The sale of incandescent lamps standardized for candle-power, ampere or watt consumption and of standard cells will be made a special feature, and certificates will be issued by the bureau upon all instruments sent to it for testing or calibration.

The president of the company is Mr. J. W. Lieb, Jr., associate general manager of The New York Edison Company. Mr. Wilson S. Howell, who has been identified with many electric lighting companies, is the manager of the company. The bureau testing officer is Dr. Clayton H. Sharp, a graduate of Hamilton College, New York, and of Cornell University. Dr. Sharp has also studied in the University of Leipsic, where he undertook special work in physics. He was for a number of years instructor in physics and applied electricity at Cornell University. With Dr. Sharp is associated a corps of competent assistants.

Dr. A. E. Kennelly, of Harvard University, is associated with the bureau in the capacity of consulting engineer, the company having arranged to avail itself of Dr. Kennelly's services in connection with any special work which the bureau may desire to undertake.

Small Alternating-Current Motors.

In no branch of electrical design have more obstacles been encountered than in that dealing with alternating-current motors, and the greatest difficulties have been with respect to small motors for high-frequency circuits. In the latter case, aside from the matter of starting torque and electrical efficiency *per se*, a low power factor has had to be dealt with. The General Electric Company announces that it has succeeded in developing a line of single-phase motors for a frequency as high as 125 cycles, in which both of the above-mentioned defects have been overcome. That is, they start under full load with only a moderate current and operate at practically 100 per cent. power factor at all loads.

These results are secured by the use of a condenser, which, however, is not employed in shunt to the motor, but energized by a tertiary motor circuit which is induced by the motor armature. In consequence, the motor does not require a sine wave of e. m. f. usually required when using condensers, but operates equally satisfactorily and with practically 100 per cent. power factor on any wave shape of e. m. f., that is, any kind of alternating-current generator. The condenser and its compensator are permanently connected to the motor and involve no additional operation in starting. The motor is started in the same way and with the same ease as any polyphase induction motor.

The construction of these motors is similar in all cases, and in the self-starting motors for single-phase circuits condenser-compensators are used for producing starting torque and eliminating wattless lagging current.

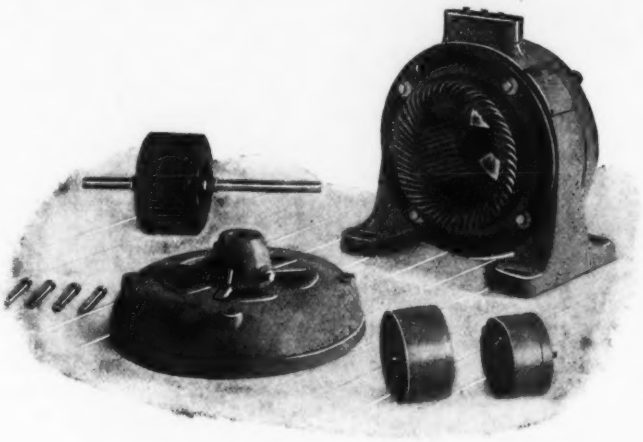


FIG. 1.—½-HP, 125-CYCLE MOTOR.

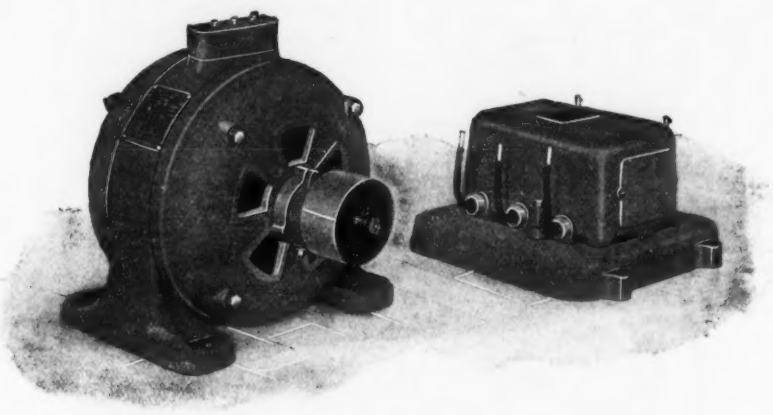


FIG. 2.—2-HP, 125-CYCLE MOTOR WITH CONDENSER COMPENSATOR.

The construction does not differ materially from that of three-phase motors. The field winding is of the three-phase type, but is differently proportioned in the single-phase motor than in the motor for three-phase circuits. The condenser produces a current in the windings across which it is connected, which acts as exciting current of the motor, so that the motor takes only the energy current from the supply circuit, and at practically 100 per cent. power factor, and thereby consumes current only proportional to its load.

Since condensers of given capacity can be made much more compactly for high than for low voltage, motors wound for low voltage are provided with transformers, or compensators which raise the voltage of the current supplied to the condenser. The use of the condenser results in a single-phase motor with all the good characteristics of the standard three-phase motor, and fully as satisfactory, but superior thereto in its power factor, that is, by the absence of lagging currents.

The frame is arranged so as to protect the windings and moving parts. The field winding is composed of form-wound coils inserted in the laminated field. The armature winding consists of bare copper bars in the smaller motors, but in the larger sizes an insulated winding is used. The ¼ and ½-hp motors are provided with centrifugal clutch pulleys, which enable the armatures to reach speed before the load is applied. This clutch consists of a split ring which is expanded by means of a centrifugal weight so as to engage the inner surface of the pulley when the proper speed has been reached. The larger motors are provided with a starting switch and electrical connections, which limit the current at starting, and at the same time

allow the motor to develop strong starting torque in the same way as customary with polyphase motors.

The bearings are lubricated automatically, and the reservoir requires only occasional examination to see that the oil is kept at the proper level. The motors may be adapted to wall or ceiling suspension by simply turning the bearings 90 or 180 degrees, in order to keep the oil ports in an upright position. The bearings may be turned without removing the armature. Slots are provided in the feet of the motor, to provide for adjusting the belt.

While the condenser compensators are thoroughly reliable, they should be handled with some care and not placed in a room having an excessively high temperature. The compensator is in principle simply a transformer that raises the voltage of the current taken by the condenser, and thus reduces the required condenser capacity. The compensator is used with motors wound for less than 250 volts.

A Residence Telephone.

One of the most neatly designed and compactly constructed long-distance central energy wall telephones for public exchange use or hotel systems is the residence set recently put on the market by the International Telephone Manufacturing Company, of Chicago. Fig. 1 shows the instrument complete as used for public exchange service. The cabinet-work, or case, is neatly designed and properly proportioned to receive the necessary apparatus, with ample working space between the various parts. The condenser is mounted in the base of the cabinet-work, in which it is readily placed from the back.

The long-distance transmitter is mounted on a small nickel-plated cast-brass base, to which it is hinged with a strong knuckle joint, so it may be moved up and down. The transmitter is held in position by a hard brass binding bolt and nut. A stop is provided inside of the socket joint to prevent turning the transmitter either up or down against the woodwork. The base is mounted against the cover of

FIG. 1.—TELEPHONE COMPLETE.

the case, and is firmly held in position by three heavy binding screws passing through the cover from the rear.

Both sides of the circuit of the International transmitter are taken direct from the front and back electrode by insulated cords passing through the joint and base into the box, and terminate directly on the induction coil, as will be seen in Fig. 2. The induction coil is mounted on the back in the lower end of the case. The cord terminals and wire clips are mounted on a special terminal strip, placed directly on the induction coil. The receiver cord passes into the case from the bottom and is terminated directly at the terminal clips on the coil. The line wires enter the case from the rear and are terminated inside on a pair of clips mounted on the bottom in the case, convenient for making the connections.

The rear of the back-board is provided with a slot so that the wire may be brought from the top or from the bottom of the instrument.

The gongs are mounted on the top of the case upon adjustable bell stands. The bell hammer is provided with a net, nickel-plated guard. The ringers are mounted at the top in the rear of the case and are fastened with heavy machine-binding screws passing through

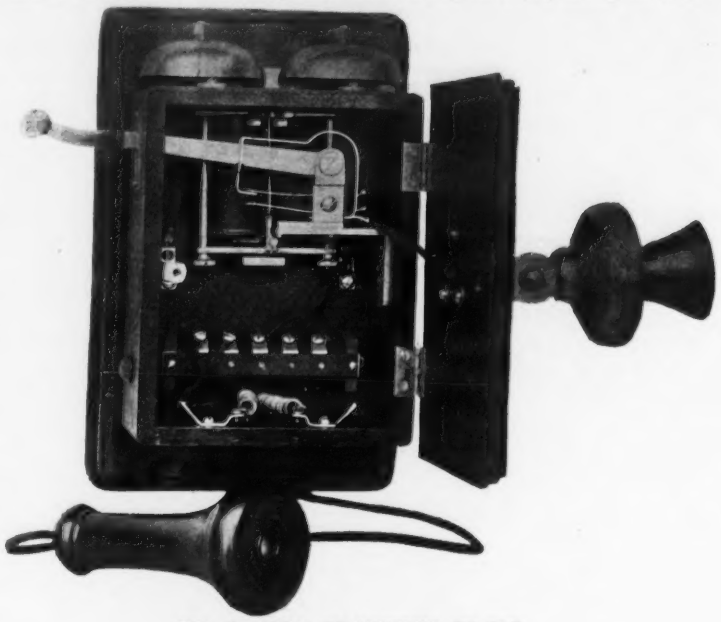


FIG. 2.—VIEW OF INTERIOR OF BOX.

from the top and screwed into the metal of the ringer. The ringer is provided with a convenient thumb-screw adjustment, so that it may be readily adjusted at one of the posts. The bell hammer pin is provided with a thread setting, into which it is screwed, so that it may be lengthened or shortened to correspond with the thickness of its mountings, so that th eringer may be adjusted to strike the gongs at the point that will secure the clearest and loudest tone.

The switch hook is mounted in front of the ringer, upon a firm metal bracket, securely clamped at the side of the case by two heavy binding screws passing through the case from the outside, threading into the metal. The switch hook is a neatly proportioned, heavy brass casting, nickel-plated and highly polished.

The switch base is a firm brass standard, in which is mounted the rubber block binding the contact springs. The spring insulating block is firmly clamped by a brass plate, held in position by a binding screw through the block, and screwing into the metal standard in the rear. The binding plate is insulated from the springs by a sheet of heavy mica.

The switch-restoring spring is a heavy German silver spring, six inches in length, passing through the rear over the switch hook and standard, and mounted in such a manner that there are no scraping or rubbing parts excepting at the contact points, which form a sliding connection. The hook passes through a wide slot in the restoring spring, from which it is insulated by a small rubber bushing at the bottom of the hook, perfectly insulating the hook from any part of the circuit.

The door of the case is provided with a screw lock, securely set into the wood-work. On the side of the case, directly under the switch-hook, is mounted a small rubber bottom, at a proper distance from the hook to prevent the receiver from marring the cabinet or from breaking the shell when hanging up the receiver.

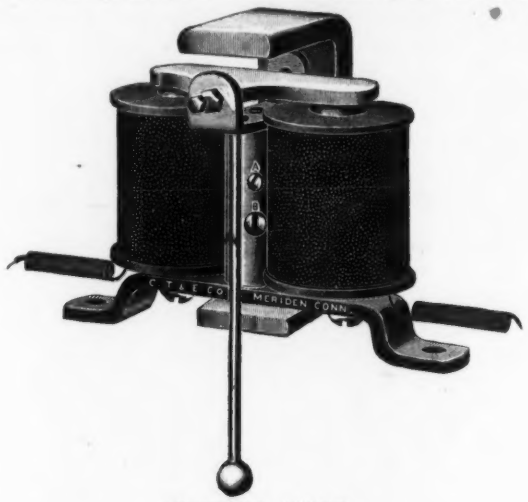
The receiver is of the double-pole, horseshoe-magnet type. The magnet and magnet coils are adjustably set into a substantial metal head, and the diaphragm is clamped to the head by a metal ring, making all working parts self-contained. All metal parts are completely enclosed in a hard rubber shell and cap. The receiver cord is of the ordinary length, and has a green silk braid covering and terminates inside of the shell at clips, which connect direct with the wires from the magnet coils. The workmanship is of the very highest grade in every detail. There being no metal parts exposed that form a part of the circuit at any time. This instrument is especially adapted for residence use.

Machine-Tool Builders.

A convention of the National Machine Tool Builders' Association was held at the Hollenden Hotel, Cleveland, Ohio, recently. The association is a comparatively new organization, having held its first meetings at Niagara Falls and New York City, in June and August of this year. Twenty-seven companies were represented, and about 40 delegates were present. The objects of the association are to facilitate and extend acquaintance among the different manufacturers of machine tools. The following officers were elected: Joseph Flather, Nashua, N. H., president; Wm. Lodge, Cincinnati, and W. P. Davis, Rochester, vice-presidents; P. E. Montanus, Springfield, Ohio, secretary; Enoch Earle, Worcester, Mass., treasurer.

A Ringer for Telephone Work.

An improved form of ringer for telephone work has been put on the market by the Connecticut Telephone and Electric Company, Meriden, Conn., the principal object in view is to lessen the amount of adjusting by simply using a beveled screw. The frame of the ringer is made of soft sheet-iron, bent into form. On the center of this is mounted a barrel or supporting post, into which fits the plunger carrying the armature. There are two screws in the barrel. One is simply a set screw which prevents any possibility of the shifting of the plunger. Another is the adjustment screw, which draws the armature near the pole of the magnet, and is screwed out or unscrewed to throw them away from the poles of the magnet. With this arrangement it is possible to adjust the ringer with a pocket knife or a screwdriver. After being adjusted, there is absolutely no chance for variation, and the change can be accomplished in the fractional part of a minute. The magnet cores on these ringers are made up of the very best grade of imported Norway iron, and the cores are wound with silk-insulated wire. The armatures are made of a high grade of Norway stock, carefully annealed and polished; then the armature is blued and coated with gun barrel lacquer, which prevents any possibility of its rusting, even if wet with salt water. It is made up and carried in stock, wound to 80, 1,000 and 1,600 ohms' resistance, and can be made up for any resistance desired.



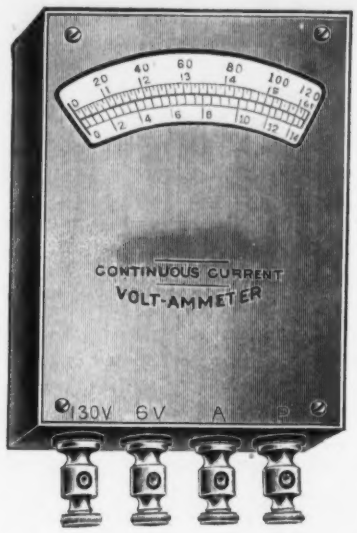
TELEPHONE RINGER.

Combined Ammeter and Double Voltmeter.

The accompanying cut represents a volt-ammeter which combines three instruments in one, and yet is small enough to be carried in the pocket though large enough for practical use. The instrument is furnished in various ranges and combinations. The particular instrument illustrated contains voltmeters reading from 0 to 6½ volts in tenth-volt scale divisions; from 0 to 130 volts in two-volt divisions, readable in single volts, as half divisions can be easily estimated; and an ammeter reading 0 to 15 amperes.

This combination gives the instrument a wide range of usefulness, and makes it specially adapted where portability and compactness are desirable. It is thus particularly useful to the electric light or telephone inspector or to any one having the care of electric light or battery circuits for testing the circuits and detecting and locating trouble.

The usefulness of this combination is apparent when it is noted that one and the same instrument will measure the pressure of storage and primary batteries either singly or in small groups, as well as higher pressures up to that of an incandescent electric light circuit, besides measuring amperes. It can thus be used for a large number of tests and measurements, such as measuring the current consumption and pressure of arc and incandescent lamps, testing dry batteries to ascertain when new ones are of full strength and when to renew old ones. The instrument is made by Louis M. Pignolet, 78 Cortlandt Street, New York.

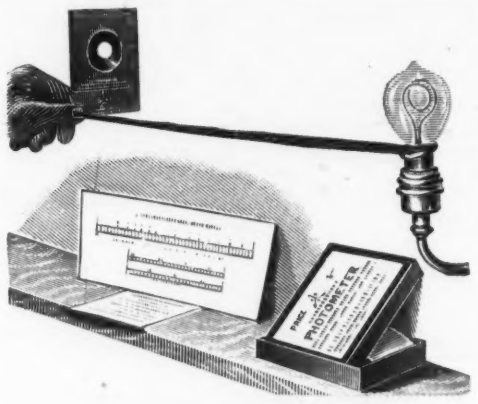


COMBINED AMMETER AND VOLTMETER.

The instruments are twice the size of the cut, and are for continuous current measurements only. They are made in the same manner as a large one, except the parts are smaller and are of the permanent magnet type, with magnets of special imported steel carefully aged to insure permanency.

Incandescent Lamp Photometer.

The pocket photometer, shown herewith, made by Everett, Edgesumbe & Co., Charterhouse Square, London, consists essentially of a modified form of Leeson disc photometer; this type possesses several marked advantages over the well-known Bunsen grease spot, particularly when lights of a somewhat different color have to be compared, as, for example, in the measurement of high and low efficiency incandescent lamps. Two lamp holders are provided, attached to an adaptor, so that connection can be made to any electric light fitting. In order to use the photometer, a divided scale, provided with a ring at each end that can be slipped over the lamp holders, has only to be put in place and stretched tight. Having obtained a point of balance in the ordinary way, the required candle-power is readily found without any calculation whatever by means of an ingeniously devised direct-reading logarithmic scale.



PHOTOMETER.

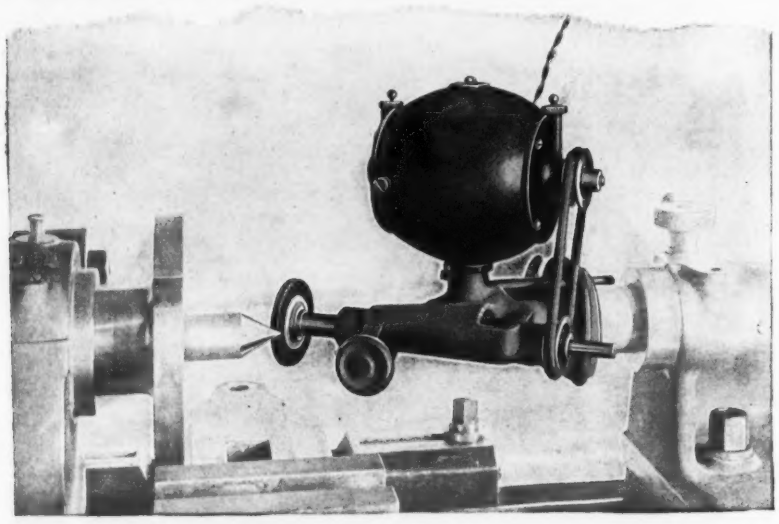
Two great difficulties which have to be surmounted in incandescent lamp photometry are: First, to obtain a handy and reliable

standard, and, secondly, to regulate the voltage With the photometer shown, no attempt is made to keep the voltage constant, but a specially standardized lamp is employed, forming part of the outfit. It has been repeatedly shown that the relation between the light emitted by an incandescent lamp bears a perfectly definite relation to the pressure at its terminals. As both the standard and the lamp under test are run off the same supply, any increase or decrease of voltage will affect both lamps equally, and the point of balance will remain unaltered. The method has the further advantage that the candle-power so found is, no matter how much the supply voltage may vary, the candle-power which the lamp would give at the standard voltage; which is, of course, what is required. It is clearly best in practice not to use the standard lamp throughout a series of tests, but to standardize another lamp from it, and to use this as a substandard.

It is claimed that with this set no specially-arranged dark room is necessary, as any moderately screened position is all that is required; or by hanging a few yards of black cloth over the photometer, a photometric chamber can be readily improvised. When it is impossible for any reason to obtain a fair absence of light, a simple correction factor can be determined once for all, as explained in the directions which accompany the instrument by interchanging the standard and test lamps, and obtaining a second point of balance. This will, however, be seldom found necessary. The direct-reading scale already alluded to can be used to obtain the efficiency of the lamp in watts per candle-power, from the candle-power and measured current. The operation is perfectly dead-beat, so that the readings can be taken with the utmost rapidity. It should be mentioned that the same instrument can be used for direct or alternating current, as required. In this case also, fluctuations of voltage will have but little effect on the result, and unless extreme accuracy is required, no voltmeter need be employed.

Electrically-Driven Center Grinder.

The accompanying illustration shows a new style of electrically-driven center grinder, manufactured by L. S. Heald & Son, Barre, Mass. The particular feature of this machine is the clamping on the tail spindle of the lathe to get the correct angle. The main frame is made with a V-shaped groove in it, and a clamping yoke which will receive any size of spindle up to 2½ or 3 inches in diameter. In this way the correct angle is given to the center without regard to whether the tail stock is set either for turning tapers or not. The grinding spindle runs in a sleeve to protect the bearings from grit and to give added stiffness to the spindle when extended. This sleeve has teeth cut in the under side in which a pinion runs, which connects with a small hand wheel, shown in the center of the cut. This is used for feeding the grinding wheel across the work, and makes a very smooth working machine.



ELECTRICALLY-DRIVEN GRINDER.

The style of machine shown grinds at a fixed angle of 60 degrees, but machines are also made in larger size which will grind angles varying between 55 degrees to 75 degrees, inclusive. The firm builds these machines in three different styles—hand-driven, friction-driven by means of a friction roll running on the belt cone of the lathe, and electrically-driven. In the electrically-driven machine the mounting of the motor above the grinding spindle is commended because it gives a chance for end play of the armature shaft and also an opportunity of running the motor at its most efficient speed, as well as the grinding wheel.

The American Oil Filter.

A new oil filter which has just been placed upon the market by the Burt Manufacturing Company, of Akron, Ohio, is shown in the accompanying illustration. It has been especially devised for the filtering of very heavy grades of oil which cannot be successfully cleaned in an ordinary filter because of the liability to clog. It is stated that such oils are readily purified by this filter.

The pan for receiving the waste oil is surrounded by a hot-water chamber, through which passes a steam coil pipe. When this chamber has been filled with warm water, and the lower part of the filter has also been filled with warm water until it flows from faucet 2, the filter is ready for operation, the proper steam connections, of course, having been previously made. The cleansing of the oil is then accomplished as follows:

Through the filtering material in the cylinder the oil makes its way into tube *B* and down upon the filter plate, *D*, where the pressure of the oil above overcomes the resistance offered by the weight of the water, and the oil spreads out in a very thin film, becoming thinner and thinner as it travels from the center to the circumference of the plate. Every particle of the oil is thus exposed to the action of the water. This process is repeated as the oil flows upon plates *D1* and *D2*. The separation of all foreign matter from the oil is thus completely effected and the remaining impurities then settle by force of gravity to the bottom of chamber *E* and are drained off by opening the valve. The pure oil is drawn from faucet 1.

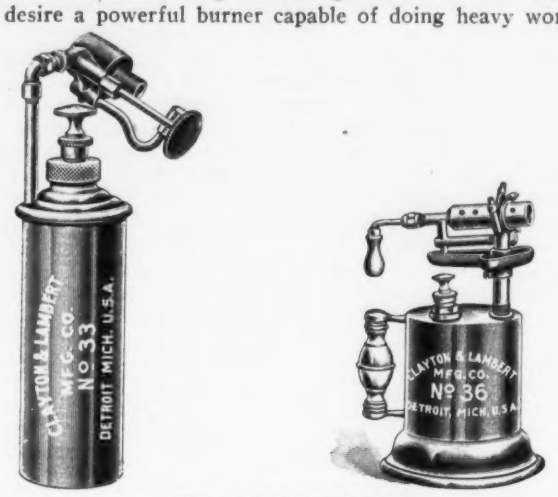
OIL FILTER.

Any kind of filtering material may be used, or none at all, and the filtering material may be removed without interrupting the oil service. The method of cleaning the filter is very simple, requiring only that the cylinder at the top be unscrewed, the filtering substance removed and the sediment pan lifted out and emptied of the accumulated material. As the dirt collects at the top in this filter, the operation of cleaning is greatly facilitated.

Torches.

We illustrate herewith two styles of torches manufactured by the Clayton & Lambert Manufacturing Company, Detroit, Mich. The torch shown in Fig. 1 is recommended for work on inside wiring, removing putty from sash, light brazing, etc. It is light in construction, can be carried in the pocket, and is always ready for use. The tank is supplied with a pump so that air pressure can be applied, making a blue blast-flame, which, while small and running to a fine point, is intensely hot. The burner hangs on a swivel, so that the flame can be thrown in any direction.

The torch shown in Fig. 2 is designed for the use of mechanics who desire a powerful burner capable of doing heavy work out of

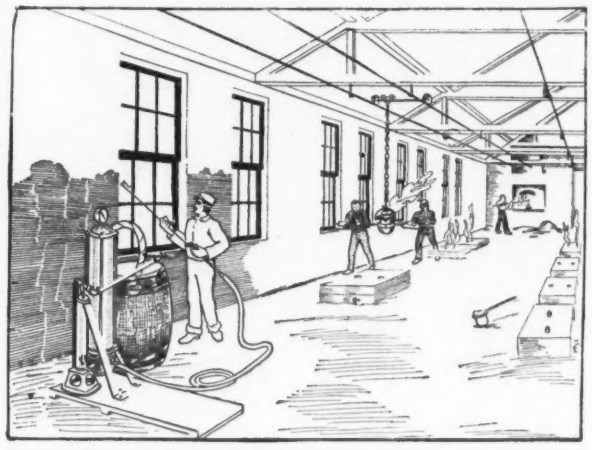


FIGS. 1 AND 2.—TORCHES.

doors in cold or windy weather. The generator has ample power and will produce a clear blue, intensely hot flame. The torch is economical in the use of gasoline and is made extra strong with heavy fittings. The brass air pump screws into the tank, and is submerged in gasoline which aids in keeping it cool.

Painting Machine.

Since more or less painting is necessary in all electrical shops and works, the machine described and illustrated herewith will be of interest. It is designed to cover surfaces of buildings and other structures of any kind with paint or other preservative coating. The principle of operation is the compressing of air and liquid into a receptacle, the compressed air discharging the liquid through a hose and nozzle in the form of a fine misty spray. By means of an air pump, a pressure of 40 lbs. may be obtained in the receptacle in two or three minutes, which is increased by pumping into it the liquid or paint to 150 lbs. The coating is laid evenly, uniformly and neatly,



PAINTING MACHINE.

and by means of an extension rod, overhead construction, high walls and ceilings may be easily painted without the construction of scaffolding. It is stated that the liquid permeates every crevice and joint thoroughly, and that one man can cover from 20,000 to 25,000 square feet of surface per day, against 1,000 square feet, which is the average day's work by the old brush method of painting. This machine is manufactured by F. E. Hook, Hudson, Mich.

Combination Rip and Cross-Cut Saw and Attachments.

The illustrations herewith show a combination self-feed rip and cross-cut saw and moulding and scroll sawing attachments for same. This machine is operated by foot and hand power, or can be run by motor power. They are used extensively by carpenters, cabinet makers, etc., and by their particular construction they are adapted to the requirements of electrical workers for making boxes and finishing the wood work of electrical apparatus, etc.

The saw has a strong and rigid iron frame, cold rolled steel shafts, with hand-scraped babbitt metal-lined boxes, adjustable to take up the wear. The combination wood and iron table top is 28 inches wide by 36 inches long; the middle portion (10 x 36) is of iron, planed perfectly true. The table is hinged at the back and can be adjusted up or down by a hand-screw in front for rabbetting, grooving, dadoing, etc. The self-feed ripping device is self-adjusting for all thicknesses of wood, is positive in its action, power being transmited by gears. The self-feed has three changes of speed. This device is easily detached, leaving the table free for cross-cutting, etc. The extension rolls increase the length of the table to seven feet,

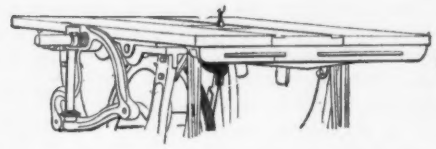


FIG. 1.—MOULDING ATTACHMENT.

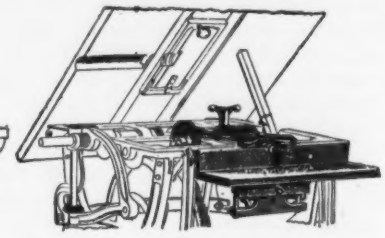


FIG. 2.—BORING ATTACHMENT.

making it valuable for cutting long stuff; they can be instantly folded down out of the way when not in use. It is provided with two hand powers, both arranged to allow the operator a natural, upright and easy position. The hand power (for one or two cranks), at the rear of the machine, leaves an entirely free table for cross-cutting (any length), dadoing, etc. The foot power has a powerful walking motion. Power is transmitted entirely by automatic machine-cut gears and chain belts, doing away with slip or lost motion, and running smoothly. It is claimed that with this machine one man can easily rip soft wood up to 3½ inches thick, and hard wood to 2 inches, doing the work of four men with common hand saws, and that it is equally valuable for cross-cutting, mitering, etc.

The boring attachment can be adjusted to the machine as quickly as changing a saw. It has an adjustable sliding table and stop to gauge the depth of hole. The scroll saw attachment can be quickly placed in position on the machine, making a strong and serviceable scroll saw, with large capacity. It will cut up to three inches thick

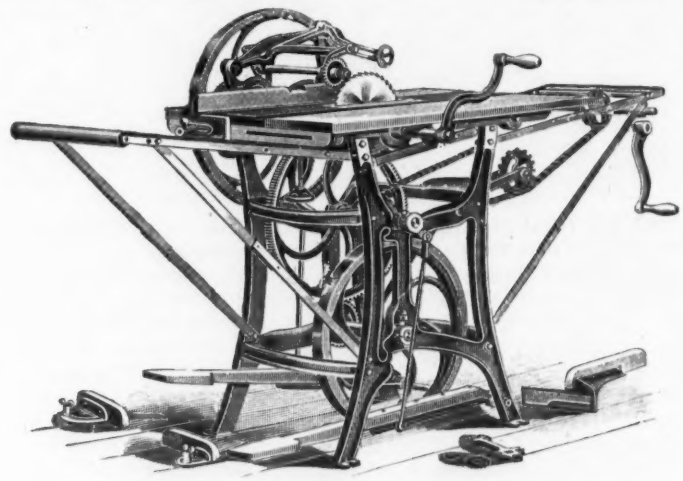


FIG. 3.—COMBINATION SELF-FEED AND CROSS-CUT SAW.

and swing 24 inches. It has adjustable saw clamps, the wooden arms being mounted on pivot rocker plates. The moulding attachment is designed for edge moulding, beading, etc., on either straight, curved or irregular work. The spindle has a vertical adjustment for different thicknesses of work, and is made to rotate in either direction to suit the grain of the wood. The machine with its attachments is made by the Seneca Falls Mfg. Company, Seneca Falls, N. Y.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money closed at 6 per cent. for all dates. It was offered with some freedom, but the rates were unattractive to borrowers in many instances. The stock market was dull, and speculative activity decreased greatly in spite of the easing of money as a result of the government bond purchases; the ending of the coal strike also failed to stimulate the market. Little interest was shown in the industrials, although the United States Steel stocks seemed to have a fair amount of support in the early transactions. There was some buying of Amalgamated Copper, said to be for inside interests. All of the traction and electric stocks shared in the general weakness of the market, and trading in them was comparatively small. Brooklyn Rapid Transit closed at 63, a net loss of 1¼ points, and Metropolitan Street Railway 104, a net loss of 1½ points. The lowest and highest quotations of these stocks, respectively, were 62⅜, 64¾ and 138¾, 142¼. General Electric dropped to 185¼, the highest point reached being 189, 187 being the closing quotation, a net loss of 1½ points. Westinghouse, common and preferred, were exceptions, common closing at 220, a net gain of 3 points, and preferred at the same figure, being a net gain of 5 points. Western Union closed at 91¾, which was practically the lowest figure of the week, representing a net loss of ¼ point. Other closing quotations were American District Telegraph 37, a net decline of 3 points, and Commercial Cable 180, a net gain of 5 points. In Boston there was a quieter tone in the market, with an easier tendency. American Telephone and Telegraph closed 3 points down in price, while General Electric closed 3 points higher. Following are the closing quotations at New York on October 28:

NEW YORK.

	Oct. 21.	Oct. 28.		Oct. 21.	Oct. 28.
American Tel. & Cable.	92	90	General Electric	187	185
American Tel. & Tel.	164½	163	Hudson River Tel.	—	107
American Dist. Tel.	39⅝	39¼	Metropolitan St. Ry.	139¾	139½
Brooklyn Rapid Transit	63	62½	N. E. Elec. Veh. Trns.	⅜	—
Commercial Cable	—	—	N. Y. & N. J. Tel.	162	—
Electric Boat	28*	18½	N. Y. E. V. T. Co.	13¼	12
Electric Boat pfd.	45*	37	Tel. & Tel. Co. Am.	—	—
Electric Lead Reduc'n.	3⅝	3⅝	Western Union Tel.	91¾	91
Electric Vehicle	5	4½	Westinghouse Company.	210	213
Electric Vehicle pfd.	13	11	Westinghouse Co. pfd.	—	213

BOSTON.

	Oct. 21.	Oct. 28.		Oct. 21.	Oct. 28.
American Tel. & Tel.	165	164½	Western Tel. & Tel. pfd.	100½	99
Cumberland Telephone	—	—	Mexican Telephone	2¼	2⅛
Edison Elec. Illum.	—	270	New Eng. Telephone	139	138¼
General Electric	—	185½	Westinghouse	210	213
Western Tel. & Tel.	—	28½	Westinghouse pfd	—	213

PHILADELPHIA.

	Oct. 21.	Oct. 28.		Oct. 21.	Oct. 28.
American Railways	—	—	Phila. Traction	98½	97⅞
Elec. Storage Battery.	—	85	Phila. Electric	8⅝	8⅝
Elec. Storage Bat'y pfd.	—	—	Pa. Elec. Vehicle	1	—
Elec. Co. of America.	9½	9⅝	Pa. Elec. Vehicle pfd.	—	—

CHICAGO.

	Oct. 21.	Oct. 28.		Oct. 21.	Oct. 28.
Central Union Tel.	—	—	National Carbon pfd.	99½	100½
Chicago Edison	—	—	Northwest Elev. com	—	—
Chicago City Ry.	212	212	Union Traction	17¼	17¼
Chicago Tel. Co.	—	—	Union Traction pfd.	50	47
National Carbon	30	30½*			

* Asked.

AMERICAN UNION ELECTRIC CO. IN RECEIVER'S HANDS.—The American Union Electric Company, of 15 Cortlandt Street, New York, was placed, Tuesday, in the hands of a receiver, at the instance of F. C. Hollins, of the financial house of F. C. Hollins & Co., 11 Wall Street, New York. The company was organized only last summer, with an authorized capital of $7,000,000, for the purpose of acquiring the business of several railway equipment and electrical concerns. It took over the Morris Electric Company, the Union Railway Power and Electrical Company, the Falcon Electric Manufacturing Company, the Electric Motor Specialty Company, the Fountain Manufacturing Company, the Federal Manufacturing and Specialty Company, the Refrigerator Machine Company, and the Metropolitan Switchboard Company, carrying with it the Murphy patents. The company has operated an extensive plant at Ampere, N. J., for the manufacture of rail bonds, trolley wheels, fare registers, trucks and sweepers, headlights, cars trimmings and electrical devices. At the former factory of the Metropolitan Switchboard Company, located in West Twenty-ninth Street, New York, switchboards and special panel-board work were manufactured by the American Company. The management of the company was, until lately, in the hands of Elmer P. Morris, S. Marsh Young, E. P. Ewing and J. Fountain. It is said that the breakdown of this consolidation will give a definite quietus to some other like projects that have been afloat in the atmosphere of Wall Street.

DEAL IN DETROIT LIGHTING.—The North American Company is understood to have purchased control of the Detroit Electric Light Company for $4,000,000, which, however, is to be paid in installments. The first of these is to be turned over this week, and will be $2,400,000, or 60 per cent. The purchase price was subscribed by a syndicate composed of several large banking houses. It is the intention of the North American Company to build a new power house to supply Detroit with light and power. The acquisition of this company is therefore expected to result in great benefits to the North American Company, which controls similar companies in Milwaukee, St. Louis, Cincinnati and other Western cities. These transactions are declared to be mainly responsible for the continued strength of North American stock, which, although it has not paid any dividends, has been selling above 120 for some months. There has been a report on the Street that the company would soon declare a dividend, but this is denied by persons familiar with the property. It is not denied, however, that dividend payments may be begun next year.

DIVIDENDS.—The directors of the Westinghouse Electric and Manufacturing Company have declared a quarterly dividend of 1¾ per cent., payable November 15. The Hudson River Telephone Company has declared the regular quarterly dividend of 1½ per cent., payable November 1. Twin City Rapid Transit directors have declared a quarterly dividend of 1¼ per cent. on the common stock, payable November 15. Chicago Edison directors have declared the regular quarterly dividend of 2 per cent, payable November 1. Books close October 24 and reopen November 1.. It is officially reported that the company is doing a splendid fall business. Allis-Chalmers directors have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock. The directors of the Nassau Electric Company have declared a dividend of 4 per cent. per annum on the preferred stock, payable November 15 to stock of record November 6. The American District Telegraph Company, of New York, has declared a semi-annual dividend of 1 per cent., payable November 15. Books close November 5 and reopen November 17.

CONSOLIDATION IN ST. LOUIS.—A deed of trust for $10,000,000 was filed in the recorder's office at St. Louis recently by the Union Electric Light and Power Company. This is a step in the consolidation of the Imperial, the Citizens' and the City Lighting Companies, details of which have already been given. The mortgage secures the $10,000,000 issue of bonds that is to be made to take care of the underlying bonds of the three component companies, and also give the new corporation a working capital to enable it to extend its facilities and widen the field of its service and operation. The new bonds will run for 35 years, and will be handled by the Mississippi Valley Trust Company's bonds department.

CONSOLIDATION OF LIGHTING INTERESTS.—It is stated that negotiations are under way to consolidate a large number of gas and electric lighting companies now operating as independent concerns and at present controlled by a group of prominent Western capitalists and Frank Tilford and Henry R. Wilson and their associates in the East. It is probable that an operating company will be formed to acquire ownership of these plants. The most important properties affected by this contemplated consolidation are the New York and Queens Electric Light and Power Company, the Newtown and Flushing Gas Company, and the Williamsport (Pa.) Gas Company.

MACON, GA., CONSOLIDATION.—The merger of the Macon Light and Railway Company and the Macon Consolidated Street Railway Company has been consummated. The officers are: T. J. Garling, Macon, president; W. W. Mackall, Savannah, vice-president; J. H. Hentze, Macon, secretary; E. L. Douglass, Savannah, treasurer. The merger involves a capitalization of $1,000,000, of which $70,000 stock has been issued, the rest remaining in the treasury. The board authorized an expenditure of $164,000 for new equipment.

THOMSON EUROPEAN WELDING.—The affairs of the Thomson European Electric Welding Company are now being wound up pursuant to a decree of dissolution issued by the supreme court of the State of Maine. There will be a final dividend, payable to stockholders from the assets of the company. A dividend of 2 per cent. from the assets of the company has already been declared.

A SOUTHERN TELEPHONE DEAL.—The People's Independent Telephone Company, of Paducah, Ky., has bought the Alexander system, comprising 150 miles and 1,200 subscribers in adjoining counties, for $50,000.

Commercial Intelligence.

THE WEEK IN TRADE.—The reports received by the mercantile agencies indicate that favorable features dominate the trade and industrial situations. Some reduction in the demand for Fall and winter goods is noted, but business on next spring's account tends rather to expand, and a similar tendency is noted in retail business, particularly at the East, where the fear of a coal famine has been removed by the actual resumption of work. In agricultural lines, favorable features are found, and at the South good weather prevails, which is favorable to the cotton crop. The railway earnings continue to show gains over last year's exceptional returns. A deficiency of motive power, no less than a shortage of car capacity, is noted at many widely separated centers, particularly in Pennsylvania and the Central West and in the Pacific Northwest. This condition, however, is largely a reflection of excessive prosperity rather than of any depressing element. Manufacturers of machinery expect to run double time to keep up with the business offered. In the iron trade, the heavier forms of finished material remain very strong. Structural iron and steel plate for ship building purposes hold strong. A cut in the price of wire and nails has already had the effect of encouraging consumption. The demand for building materials continues active, and in the lumber regions strength is the main feature. In the metal market, copper recovered in price through the announcement of the settlement of the coal strike, and between 15,000,000 and 20,000,000 pounds were sold for delivery during the next three months, at prices ranging from 11.60 cents to 11.80 cents. In the meantime, prices reached 12 cents for all grades. The closing quotations are: Lake, 12 cents nominally; electrolytic, 11.62½ cents to 11.87½ cents; casting stock 11.62½ to 11.82½ cents. The number of business failures for the week ending October 23, as reported by *Bradstreet's*, aggregated 194, as against 203 the previous week, and 223 the corresponding week last year.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York for the week ended October 4: Antwerp—30 pkgs. material, $2,215. Argentine Republic—15 pkgs. material, $887; 85 pkgs. machinery, $4,441. Brazil—76 pkgs. material, $9,216; 87 pkgs. machinery, $3,400. Berlin—1 pkg. machinery, $35. Bremen—4 pkgs. material, $150. Birkenhead—35 pkgs. machinery, $14,276. Budapest—3 pkgs. material, $95. British West Indies—30 pkgs. material, $680. British East Indies—16 pkgs. material, $888; 8 pkgs. machinery, $1,225. Copenhagen—1 pkg. machinery, $30. Chili—3 pkgs. material, $500. Cuba—3 pkgs. machinery, $1,000; 48 pkgs. material, $1,404. Central America—12 pkgs. material, $297; 1 pkg. machinery, $50. Glasgow—15 pkgs. material, $867. Havre—15 pkgs. material, $217; 7 pkgs. machinery, $435. Hamburg—1 pkg. machinery, $60; 37 pkgs. material, $2,020. Ipswich—5 pkgs. material, $2,737. Kiel—6 pkgs. material, $244. Liverpool—236 pkgs. machinery, $20,258; 66 pkgs. material, $2,938. London—19 pkgs. machinery, $973; 58 pkgs. material, $3,033. Mexico—121 pkgs. material, $4,470; 6 pkgs. machinery, $487. Manchester—1 pkg. material, $158. Newcastle—2 pkgs. machinery, $200. Nova Scotia—48 pkgs. material, $1,946. Portsmouth—6 pkgs. material, $510. Rotterdam—2 pkgs. material, $100. Riga—5 pkgs. material, $100. Southampton—58 pkgs. material, $1,061. U. S. Colombia—7 pkgs. material, $295. Venezuela—56 pkgs. material, $5,122. The following are the exports of electrical materials from the port of New York for the week ending October 18. Antwerp—13 pkgs. machinery, $925. British East Indies—15 pkgs. material, $2,529; 17 pkgs. machinery, $1,444. British West Indies—18 pkgs. material, $295. Barcelona—37 pkgs. material, $1,000. British Australia—41 pkgs. material, $1,998. Cuba—266 pkgs. material, $950. Chili—1 pkg. material, $90. China—3 pkgs. material, $85. Equador—1 pkg. material, $33. Glasgow—4 pkgs. material, $138. Genoa—2 pkgs. material, $37. Hamburg—18 pkgs. material, $462; 7 pkgs. machinery, $476. Havre—1 pkg. machinery, $100. Ipswich—4 pkgs. machinery, $150. Japan—135 pkgs. material, $12,736. Liverpool—188 pkgs. machinery, $12,207; 6 pkgs. material, $200. London—1 pkg. machinery, $1,165. Liberia—1 pkg. machinery, $55. Madrid—1 pkg. material, $783. Manchester—200 pkgs. machinery, $21,136. Milan—2 pkgs. material, $222. Naples—4 pkgs. material, $100. Nova Scotia—18 pkgs. material, $2,236. Philippine Islands—212 pkgs. material, $34,394. Siam—64 pkgs. material, $3,864. Southampton—30 pkgs. material, $619. Venezuela—6 pkgs. material, $254; 1 pkg. machinery, $50.

SOME HEINE CONTRACTS.—The Heine Safety Boiler Company, of St. Louis, Mo., local offices 11 Broadway, is about to make shipment of two 300-hp units for the plant of the Great Boulder Gold Mining Company, of Great Boulder, West Australia, which is to be electrically equipped. The Auburn Interurban Railroad Company has placed a contract with the Heine people for five 300-hp boilers for its new plant. The generators will be of Westinghouse build, three 350-kw machines having been ordered. The engines, three of 500-hp each, will be of Corliss type. They will be turned out by the Westinghouse Machine Company. The Philadelphia and Lehigh Valley Traction Company's new plant, at Allentown, Pa., is to be installed with 2,464 hp of Heine boilers in 414-hp units. The Colonial Construction Company, of Syracuse, N. Y., has let contracts for the equipment of a 2,000-hp cement plant, to be erected by the Hudson Cement Company at Hudson, N. Y. All the machinery is to be operated by electricity. There are to be four 500-hp Heine boilers. The engines will be of Murray type. Keystone generators are to be installed. The Danbury and Bethel Gas and Electric Company, of Danbury, Conn., has requisitioned for a 500-hp Heine boiler. Herbert A. Wagner is consulting engineer for the Danbury company. The Keystone Improvement Company has placed a contract for four 275-hp Heine boilers, to be installed in an extension of the Lehigh Traction Company's plant, at Hazelton, Pa. Brown, Fitchburg, Mass., engines will be also installed. L. B. Stillwell is acting as consulting expert in the matter. An extension of the Edgewater, N. J., plant of the New Jersey and Hudson River Railway and Ferry Company, will mean the installation of two 500-hp Heine boilers. Ford, Bacon & Davis are the engineers. The Virginia Railroad Company has requisitioned for a 300-hp boiler unit, to be installed in the Atlantic City plant of the West Jersey and Seashore Railroad Company, and 1,000 hp of Heine boilers in three units are to be furnished the Taunton Municipal Electric Light Company, of Taunton, Mass.

ELECTRICAL EQUIPMENT FOR BIG WESTERN PLANT.—The Standard Motive Power Company, Consolidated Exchange Building, New York, are to build a $1,000,000 plant at Canal Dover, Ohio. The initial capacity of the plant will be 1,000 hp, which will be eventually increased to 3,000 hp. Four 150-kw turbines are to be furnished by the De Laval Steam Turbine Company. The boilers—4 units of 250-hp each— will be built by the Stirling Company, of Chicago. The machine-shop equipment will consist of over 200 tools, which, it is estimated, will represent an expenditure of over a quarter of a million dollars. Mr. George L. Fowler has drawn up the specifications for the company.

TO PURCHASE EQUIPMENT FOR TOKIO PLANT.—The plant of the Tokio Electric Light and Power Company is to be extended, principally for the purpose of furnishing energy to operate the electric traction system, to be constructed by the Tokio Street Railway Company, to which some reference has already been made. The present equipment has a capacity of 4,000 hp. It is to be increased by 1,200 hp. Mr. Y. Nogami, chief engineer of the first-named company, is expected to arrive in New York next week.

ROCHESTER AND BUFFALO POWER HOUSE EQUIPMENT.—The principal contracts for the equipment to be installed in the Canandaigua power station of the Rochester and Buffalo Street Railway Company have been decided upon. Thayer & Company, incorporated, of 39-41 Cortlandt Street, New York, have secured a contract for 2,000 hp of Cahall boilers. The engines will be of Williams type. The generators are to be of Westinghouse manufacture.

THE OTIS ELEVATOR COMPANY has recently received the contract for the elevator and dumb-waiter equipment of the new Astor Hotel, Long Acre Square, Forty-fourth to Forty-fifth Streets, New York. The plant consists of seven electric passenger elevators, two electric servants' elevators, eleven electric dumb-waiters, and three electric sidewalk lifts. Messrs Clinton & Russel are the architects, and John Downey the general contractor.

SANTO DOMINGO ELECTRIC ROAD.—An electric railway is to be constructed from a point on the line of the Pacific Railway to Alajuela and Heredia, terminating in the Province of Santo Domingo. Mr. Emilio Joubert, a special purchasing agent of the Santo Domingo Government, is now in the United States with a view to placing contracts. He may be found at the Export Club of America, 82-88 Wall Street, New York.

POWER HOUSE EQUIPMENT FOR JAPAN.—The plant of the Kioto Electric Traction Company, of Kioto, Japan, is to be equipped with two 500-hp boilers, manufactured by the Heine Safety Boiler Company, of St. Louis, Mo., whose New York offices are under the management of Mr. Paul H. Brangs. The engines will be furnished by McIntosh, Seymour & Company. The generators are to be of General Electric build.

CONTRACTS PENDING FOR PORTUGUESE ELECTRIC ROAD.—The Anglo-African house of Wernher, Beit & Company, which concern financed the City of Mexico and the City of Lisbon electric traction systems, both built with American equipment, will shortly let contracts for the construction of additional lines in the Portuguese capital. The London offices of the firm are in Bishopsgate Street, London, E. C.

MONTEREY ELECTRIC TRACTION.—Some further important details are to hand regarding the projected electric traction system to be constructed in the city of Monterey, Mexico, to which some reference was made in our issue of October 18. Since that date Sperry, Jones & Company, of Baltimore, Md., which concern is financing the enterprise, has purchased the Ferrocarriles de Monterey y Topo-Chico, a horse road 15 miles long, known as the Slayden system, of which Mr. S. W. Slayden, of 50 Broadway, is the president. The new electric lines will be about 30 miles in length. The enterprise will entail an expenditure of about $1,500,000. Everything in the way of power-house equipment, cars, trucks, motors, etc., will be purchased in the United States. First and second class passengers will be carried. The large double-truck cars will be divided by a partition. One compartment will be for the accommodation of passengers paying first class fares, and the other for second. Freight will be carried on specially constructed flat trucks. Sixty and 70-pound rails are to be used. The capacity of the power house will be 1,500 hp. Mr. R. B. Sperry, the senior member of Sperry, Jones & Company, accompanied by Mr. A. W. McLimont, the general manager of the new undertaking, will return to the United States this week, and will immediately place contracts for equipment, etc. It was reported this week that the General Electric Company, the Westinghouse interests, and the Stanley Electric Manufacturing Company were after the contract. It is expected that 20 miles of the road will be in operation within 12 months.

THE WHITE MOUNTAIN PAPER COMPANY has placed contracts for a substantial part of initial capacity of its new plant. Practically everything will be operated by electricity. In the first instance the capacity will be about 12,000 hp, to be considerably added to in the near future, it being expected that some $7,000,000 will be expended before the plant is finally completed. The electrical apparatus will be furnished by the Westinghouse Electric and Manufacturing Company. There are to be three 1,000-kw, 440-volt, 94 r. p. m. revolving-field engine-type alternators; one 300-kw, 440-volt, 100 r. p. m. revolving-field engine-type alternator, complete with exciters, and 5,500 hp in induction motors, varying from 5 hp to 400 hp each. Ten motors of 300-hp each will be direct connected to a constant speed line of paper machines. The engines will be built by the Hooven, Owens & Rentschler Company. There will be three 1,500-hp cross-compound engines for driving the Westinghouse generators. One 450-hp cross-compound engine is for lighting purposes. Two 1,200-hp engines and one 750-hp capacity will be direct connected to shafting for power transmission throughout the plant. Ten single-cylinder engines, representing an aggregate of 3,350 hp, are to be used for operating the paper machines. These engines will be capable of showing a wide range of speed, and will be built so as to permit of the change of speed in the paper machinery being controlled from them. The boilers to be installed in the plant will be of Babcock & Wilcox build.

EQUIPMENT FOR ANOTHER JAPANESE ROAD.—Contracts are now being placed for equipment in connection with the conversion to electric motive power of part of the steam railroad between Iidamachi and Hachioji, suburbs of Tokio, Japan. In the first instance, 4½ miles of road will be changed to electric traction. The contract for the boilers has been taken by the Stirling Company, of Chicago, Ill. There will be three units of 250-hp each. This contract was secured through the Japanese house of Okura & Company, which concern has a New York office located in the Bowling Green Building. The generators and engines will be supplied by the Siemens & Halske Company, of Berlin. The contract for the car trucks and motor equipments are understood in local Japanese trade circles not to have been placed yet. The initial equipment of the road will be 50 cars. The American electrical engineering and contracting firm of Bagnall & Hilles, of Yokohama, is reported to have received a contract for various material for the new road and the Japanese house of Mitsin & Company, 445 Broome Street, New York, has also been allotted a contract. The new system will be known as the Okubo Electric Railway.

EQUIPMENT CONTRACTS FOR MEXICAN POWER PLANT.—The Guanajuato Power and Electric Company, in which Chas. A. Coffin, president of the General Electric Company; John Hays Hammond, the mining expert, and other men prominent in electrical and mining circles are interested, has just let some contracts for the equipment of the power plant to be built on the River Duero, near the city of Zamora, in the State of Guanajuato, Mexico, to furnish power 110 miles to Guanajuato. The initial capacity of the plant will be about 5,000 hp. The General Electric Company has secured a contract for two generators of 1,500 kw each. The Pelton Water Wheel Company has been awarded a contract for two 2,300-hp wheels. The contract for the pipe line, which calls for 3,300 feet of 57-inch, 63-inch and 69-inch steel rivetted pipe, has been allotted to Jos. T. Ryerson & Son, incorporated, of Chicago, Ill. The capacity of the plant will be considerably increased in the near future.

"AXLE LIGHT" IN EUROPE AND JAPAN.—The Consolidated Railway Electric Lighting and Equipment Company, 100 Broadway, New York, have advices from the British firm of Vickers Son & Maxim, that some important contracts have lately been taken for the installation of the "Axle Light" system of electric lighting on British railroads, and also on the trains of some of the principal continental European roads. The equipments are being manufactured at a special plant, located in Birmingham, by the Vickers people. A contract has been secured through the Japanese house of Mitsin & Company, of 445-447 Broome Street, New York, for several equipments for the Kuishuit railway, Japan. Among recent domestic contracts received is one from the Southern Pacific Railroad Company, for the new trains which are to run from Chicago to San Francisco, via El Paso. The cars on these trains will also be equipped with several fans, to be operated by the "axle light" system.

MEXICAN POWER TRANSMISSION PLANT.—Plans have been perfected by Harold J. Rossi, of the city of Mexico, Mex., for the construction and operation of a large electric power transmission plant, to be located on the hacienda of his uncle, Archbishop Gillow, situated near the town of San Martin, Texmelucan, State of Puebla, Mexico. It is proposed to utilize the power derived from a large waterfall to generate 500-hp of electrical energy, which will be transmitted ten miles to the town above mentioned, where more than 450 hp has already been contracted for by cotton mills and other manufacturing concerns. Later on a greater amount of power will be generated for transmission to Tlaxcala and the haciendas between San Martin and Puebla. Mr. Rossi will be in personal charge of this plant and enterprise.

OIL FILTER ORDERS.—The Atlas Portland Cement Company, of Northampton, Pa., has recently placed an order with the Burt Manufacturing Company, of Akron, Ohio, making 16 of these filters in use in its different plants. Other recent orders reported from the Burt Company were from the following concerns: The Allis-Chalmers Company, Swift & Company, American Sheet Steel Company, West Virginia Pulp and Paper Company, American Locomotive Company, Savannah Electric Company, and Armour & Company.

BALL ENGINE ORDERS.—The National Tube Works have recently placed in operation at their Middletown, Pa., plant two 450-hp engines, direct connected to Westinghouse generators. The Ball Engine Company, Erie, Pa., furnished the engines. The Pennsylvania Railroad Company, West Jersey and Seashore Line, Atlantic City, N. J., has recently installed an outfit consisting of two 150-hp cross-compound engines, built by the Ball Engine Company, direct connected to Westinghouse alternators. The generators run in parallel, and the engines are equipped with synchronizing devices.

THE YORK STREET RAILWAY COMPANY, York, Pa., has decided to expend about $25,000 in needed improvements on its lines. All of the principal streets which the line traverses will be double tracked. The rails and turn outs are made at Steelton and are of the latest and heaviest pattern, 55 feet in length, and weigh about 1,500 pounds each. The turn-outs and crossings are proportionately as heavy. The trackage is being laid under the superintendency of traction track foreman, Klinedinst. It is being laid upon a concrete base of quite a depth. This part of the work is in charge of the Vulcanite Paving Company, of Philadelphia.

MONTAUK FIRE DETECTING WIRE ORDERS.—The Montauk Fire Detecting Wire Company, 100 Broadway, has recently secured a contract through E. H. Kirkby, of 147 Elizabeth Street, Melbourne, Australia, for the installation of its system in Her Majesty's Theatre there. Among domestic orders lately secured is one calling for several thousand feet of wire for the Ashland House, Fourth Avenue and Twenty-fourth Street, New York. The Jenney Construction Company, of 563 Fifth Avenue, New York, is sending in several orders for wire, to be installed in private residences.

DETROIT AND THE SOO.—Mr. Francis H. Clergue, of the Canadian Soo, while in Detroit recently is said to have announced that plans had already been perfected for supplying Detroit with electricity direct from the big power plant he has just completed at the Falls of Sault Ste. Marie. The plan is to convey the current by means of cables carried on towers, 60 feet high. It is proposed to furnish Detroit with 20,000 hp at first, increasing the amount later to 200,000 hp. Transforming stations along the route will supply smaller cities.

ENGINES FOR HOKKAIDO, JAPAN.—McIntosh, Seymour & Company, of Auburn, N. Y., and the Havemeyer Building, New York City, has just made shipment of two 400-hp horizontal cross-compound engines to Japan, for installation in the plant of the Hokkaido Colliery and Railway Company. The contract was secured through H. Becker & Company, whose offices are in the Curtis Building, 35 South William Street, New York. The generators will be made by Siemens & Halske, Berlin, Germany.

NEW LUNKENHEIMER FACTORY.—At Cincinnati last week the fine new factory of the Lunkenheimer Company was opened with great eclat, and in the presence of large crowds of merchants, city officials, employees, etc. ELECTRICAL WORLD AND ENGINEER was represented by J. M. Wakeman and Western Manager J. V. S. Church. The company itself, represented by Mr. and Mrs. Carl Lunkenheimer, treasurer; Mr. Edmund R. Lunken, president; Mr. Samuel L. Moyer, engineer, and Mr. D. T. Williams, vice-president provided refreshments, music and an excellent vaudeville. The conspicuous event of the evening was the presentation to the firm by the employees of a very handsome American flag, which was gracefully acknowledged by Mr. Lunken. The factory contains 150,000 square feet, and will give ample room to no fewer than 700 hands. It is of the latest steel construction. The general distribution of power throughout the building is quite modern; the source of energy is a 300-hp engine, which drives a 240-kw, three-phase, 220-volt, General Electric, alternating-current dynamo. The current is led out from a switchboard to the different parts of the building, where suitable motors are provided to drive the various lines of shafting. These motors are of the induction type. The power from the motors to the shafts is transmitted through what is known as the Renold silent-chain gear, which permits of a very compact arangement of motors, shafts, countershafts; runs without any noise whatever, is positively frictionless, and it also dispenses with the use of leather belts. The whole power transmission scheme in this building is the most modern of any manufacturing concern in the West. In the engine room, besides the engine driving the dynamo, there is also a large cross-compound, two-stage Laidlaw-Dunn-Gordon air compressor, which supplies compressed air throughout the shops and foundries, where it is used for driving different pneumatic tools and other similar appliances. The engine room, when finished, will be one of the handsomest in the country; the floor will be mosaic tiling, and all the fittings about the room will be of the latest type. Bell telephones connect all departments to a central exchange, which connects with the city lines, thus affording immediate communication from any point in the factory. The illumination is furnished by what is known as the Nernst lamp, made by the Nernst Lamp Company, of Pittsburg. Owing to the arrangement of the lamp, the distribution of the light is absolutely even and without shadows. The lamps are so disposed that sufficient illumination is secured without providing each operator with an individual light. In order to avoid any misunderstanding as to the nature of the products manufactured, we would state that the line of goods made in these shops consists of valves of all kinds for engines, boilers—in fact, all kinds of gas, steam, air, water, etc.; whistles, gauges, injectors, lubricators, oiling devices, oil and grease cups and engine, and boiler appliances generally. The business was founded in 1862 by the late Frederick Lunkenheimer, and, from a very small beginning, has grown to the large proportions shown by the present establishment. The company's products are sold at branch stores throughout the world, and are looked upon by engineers as possessing the very highest quality. The company is now erecting another large building, which will be occupied by the general offices and engineering force, and this will be ready for occupancy about the first of the year.

THE RHODE ISLAND AND SUBURBAN RAILWAY COMPANY is making extensive additions to its power station on Eddy Street, Providence, R. I. The plant now building was originally designed for a rated capacity of 7,500 hp, but recently the company decided to augment its power equipment and contracted with Westinghouse, Church, Kerr & Co. for a new Westinghouse vertical cross-compound Corliss engine, designed for a maximum capacity of 6,600 hp. The cylinder dimensions of the engine are 42 and 86 inches diameter, with a stroke of 60 inches. The engine will be approximately 35 feet in height, and will be direct connected to a 2,500-kw Westinghouse, 600-volt, direct-current railway generator, mounted between the main bearings together with a flywheel 24 feet in diameter, and weighing 125 tons. In encouragement of the proposed legislation upon smoke prevention, the Rhode Island and Suburban Railway Company also contracted with Westinghouse, Church, Kerr & Co. for a complete equipment of mechanical draft and Roney mechanical stokers for the 5,400-hp boilers which the new station will contain. Provision for the greatly increased boiler capacity will be made by the addition of a second story to the boiler house for the accommodation of the upper deck batteries.

THE STUART-HOWLAND COMPANY announces in a circular letter to the trade that owing to the rapid growth of its business it has been compelled for the third time in 18 months to materially increase its quarters in Boston. The latest addition includes the entire premises until recently occupied by Pettingell-Andrews Company. This will give it about 30,000 square feet of floor space, with a frontage on Denvonshire Street and Winthrop Square of about 240 feet, and when remodeled according to its plans will make a store and offices the equal if not the superior of any electrical supply store in the United States. It had much outgrown its quarters, and the added space was badly needed. Its stock is one of the largest, carefully assorted, and includes practically everything electrical. The location is in the heart of the busiest business section of Boston, within three minutes' walk of the South Terminal Station, and convenient to the car lines from the North Station, as well as from all suburban points. The Stuart-Howland Company started in business less than three years ago, and its growth, which has been phenomenal, proves what can be done by a thoroughly up-to-date business policy. Its business is now one of the largest of the kind in the country.

USE OF ELECTRIC VEHICLES BY ELECTRIC LIGHT COMPANY.—Two years ago the rapidly increasing business of the Hartford Electric Light Company was drawing so heavily upon the energies of the executive department that the appointment of an assistant to the general manager was thought necessary. While looking about for the right man, President Dunham conceived the idea that use of an automobile might help matters, and, as an experiment, he purchased one of the Electric Vehicle Company's runabouts. It was found that the machine greatly increased the scope of personal inspection of the company's work going on in different parts of the city, and the appointment of the assistant was indefinitely postponed. President Dunham says that the vehicle, which is still in commission, paid for itself in eight months. More recently the company has purchased an additional runabout for the foreman of line construction, an electric delivery wagon and a large electric emergency wagon for general utility and "trouble business." Mr. Dunham states that these vehicles have proved very profitable and have saved the company approximately a third of its labor.

WESTINGHOUSE, CHURCH, KERR & CO. report extensive sales of Roney mechanical stokers for the past month. Among the orders are the following: Carnegie Steel Company, Homestead works—12 duplex stokers, to replace another make; fifth order follows a large order given one year ago; total 15,000 hp. Lackawanna Steel Company, Buffalo—16 duplex stokers; fourth order—14,000 hp. Juniata Steel and Iron Company, Greencastle, Ind.—10 duplex stokers. Continental Tobacco Company, St. Louis, Mo.—4 duplex and one quadruplex stokers. Atlanta Rolling Mill and Tin Plate Company, Atlanta, Ind.—8 duplex stokers. Woodward & Lothrop, Washington, D. C.—6 duplex stokers. Merchants' Heating and Light Company, Indianapolis, Ind.—5 duplex stokers. Duplex and quadruplex stokers are also to be installed in J. L. Mott Iron Works, Trenton, N. J.; American Locomotive Works, Schenectady, N. Y., fourth order; Pennsylvania Railroad, Altoona, Pa., tenth order; United States Lighting and Power Company, Washington, D. C.; National Tube Company, Pittsburg, Pa., sixth order; Pressed Steel Car Company, Pittsburg, Pa., sixth order.

TROLLEY FOR MONTEREY, MEXICO.—Extensive trolley lines, with first and second class fares, is the project planned for the City of Monterey, Mexico, by Baltimore capital, represented by Sperry, Jones & Co., bankers, of Baltimore, Md. The city is a live, industrial town, with 80,000 inhabitants. This will be the first application of electricity to street-car service in Monterey. There is now a mule-car line, which this syndicate has purchased, together with concession, granted to local capitalists. There will be six different lines, aggregating 30 miles, and so constructed as to meet at the center of the city.

M. B. FOSTER ELECTRIC COMPANY has opened offices in the Fuller Building, at Broadway and Twenty-third Street, New York City. It proposes to do a general electrical contracting business, inclusive of wiring and the installation of plants. The company numbers Messrs. Freund and Cordnan, who have been engaged in the business for the past 15 years. Mr. M. B. Foster is a graduate of the Massachusetts Institute of Technology, and has been in the contracting business for a year and a half. Mr. A. C. Foster, another partner, was previously a hotel manager.

ILLINOIS ELECTRIC VEHICLE TRANSPORTATION COMPANY.—The Illinois Electric Vehicle Transportation Company is inviting bids until November 8, on 77 electric vehicles of various styles manufactured by the Electric Vehicle Company, of Hartford, Conn., all of which are equipped with chloride storage batteries. The operating equipment is also to be sold. Messrs. Samuel Insull, E. B. Russel and James E. Hays are trustees for the dissolution of the Illinois Electric Vehicle Transportation Company, Chicago.

VICTOR TURBINES FOR FOREIGN COUNTRIES.—The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, have, through their New York offices, received a contract from the Strong & Trowbridge Company, an Australasian concern, 22-24 State Street, New York, for several 30-inch Victor turbines, to be shipped to Auckland, New Zealand. An order for five carloads of turbines has also been received from the English house of Rose & Knowles, Santos, Brazil.

General News.

THE TELEPHONE.

LITTLE ROCK, ARK.—The Cabot and Lonoke Telephone Company has filed its articles of incorporation with the Secretary of State. The capital stock is $1,500. It is proposed to erect and operate a telephone line from Lonoke to Little Rock via Cabot. George Rule, Jr., is president and treasurer; R. G. Stovall, vice-president; W. A. Thompson, secretary.

DENVER, COL.—The Local Telephone Company has been incorporated in this city by S. L. Clough, W. H. Hake, C. M. Brady and others. The company proposes to operate lines in Denver and throughout the State of Colorado.

DENVER, COL.—City Attorney Sheafer, of Denver, has prepared an adverse report on the proposition of the Colorado Telephone Company to furnish the city with 18 telephones without charge, increasing the number as the population increases provided the city signs a contract not to use any other telephones or to enter into contractal relations for the use of other telephones with any other company.

FOWLER, ILL.—The Fowler Central Telephone Company has been incorporated by C. C. Haxel, L. E. Schriver, and H. Schroeder. The capital stock is $2,500.

STEWARDSON, ILL.—The Stewardson Telephone Company has been incorporated with a capital of $2,500. Incorporators: T. P. Mantz, D. M. Duddleston and William Frede.

MT. AUBURN, ILL.—The Mt. Auburn telephone exchange has been sold to Walter McKaig. The switchboard at Blue Mound was included in the purchase and will be removed to Mt. Auburn, while a larger one will be secured for Blue Mound.

JACKSONVILLE, ILL.—Representatives of twenty-three telephone companies, covering the independent field in Western Illinois, met here recently and arranged for the organization of an Illinois Telephone Traffic Association, to handle the interchange of telephone traffic and promote the interest of the independent companies.

NASHVILLE, ILL.—The Southern Union Telephone Company has completed the construction of its line in the west end of this county and its system is now complete. The district embraces the towns of Venedy, Venedy Station, Lively Grove, Stone Church, Oakdale and Coulterville. This part of the county has long been in want of means for communicating with the county seat and the outside world.

PIKE'S PEAK, IND.—The Pike's Peak Telephone Company has been incorporated to build a system in Brown, Bartholomew and Jackson Counties. The capital stock is $2,000.

SEYMOUR, IND.—The Seymour Home Telephone Company has been incorporated, the initial capital stock being placed at $15,000. The company will operate a telephone system within the city of Seymour and throughout Jackson and adjacent counties. The incorporators are E. D. L. Barber, John C. Montieth, Claude Hymer, J. H. Peters and S. A. Barnes.

EVANSVILLE, IND.—The recent action of the Cumberland Telephone Company in advertising for bids for the construction of a new exchange building is a puzzle to the city officials. The Cumberland company is under orders of the city council to remove its poles, wires and other property from the streets and alleys of the city by the middle of November. But in the face of orders to get out, the advertisement for bids for a new exchange building comes as a surprise and wakes up the slumbering telephone question. Mayor Covert is indignant at the action of the company and other city officials have expressed themselves against the company's position and in favor of municipal ownership. The telephone situation here is greatly strained, and the crisis seems to be near at hand.

WHITTEMORE, IA.—The Whittemore Telephone & Lighting Company has been incorporated here.

ELLIOTT, IA.—At the general election on Nov. 4 the question of granting a franchise by the town of Elliott to the Elliott Central Mutual Telephone Association will be voted on.

DES MOINES, IA.—The Mutual Telephone Company's managers are figuring with makers of telephone supplies on a new 6,000 connection switchboard which it proposes to install in its Des Moines plant next season and will require that it be delivered ready to set up with 4,000 connections. The board is being ordered in contemplation of the extension of the service into the country.

REDWOOD FALLS, MINN.—The Redwood County Rural Telephone Company is about to extend its lines from Wabasso to Morgan, a distance of twenty miles, with a central office at the latter point, and some forty instruments.

ST. JOSEPH, MO.—The Central States Telephone, Telegraph and Construction Company has been organized here with a capital stock of $100,000. Toll lines will be built all over Missouri, Kansas, Iowa and Nebraska. Connections will be made with the Citizens' company, of this city, the independent companies at Atchison and Leavenworth, and the Home Company, of Kansas City. The principal stockholders are W. F. Rankin, of Tarkio, and S. M. Baker, of Atchison. Over twelve thousand telephones will be connected by these toll lines.

GOWANDA, N. Y.—The Gowanda Telephone Company has been incorporated, capital $25,000. Directors: E. C. Fisher, J. M. Congdon and R. E. Congdon, Gowanda.

ELIZABETH CITY, N. C.—The Norfolk and Carolina Telegraph & Telephone Company, of Elizabeth City, has been chartered with a capital of $50,000. C. R. Johnson, of Portsmouth, Va., is the principal stockholder. M. L. Guirkin, of Elizabeth City, is also interested.

PORTSMOUTH, OHIO.—The Portsmouth Telephone Company is installing a new switchboard and will spend $20,000 in extensions next spring.

BOWLING GREEN, OHIO.—The Weston-Grand Rapids Telephone Company is receiving material for new lines and a new switchboard at Grand Rapids. Other improvements are to be made.

MARION, OHIO.—By paying $1 per year additional subscribers of the Bell Company at Caledonia will be given service to Marion without toll charges. The plan is being favorably received.

ELMORE, OHIO.—The New Ottawa County Telephone Company has been incorporated, with a capital stock of $150,000. The incorporators are E. D. Harkness, J. G. Steinkamp, George W. Luckey, Homer Metzger and Taylor Fuller.

MARSHALLVILLE, OHIO.—The Marshallville Telephone Company has been incorporated, with a capital stock of $1,000, by William Beidler, D. W. Kaufman, C. W. Biddle, H. H. Bachman, L. Hinderer, Jacob Ault, John Weiner, Edson Stinson and Benjamin Ault.

TOLEDO, OHIO.—The Toledo Home Telephone Company now has 5,000 telephones in operation. Of these 4,600 are independent telephones and 400 sub-telephones connected with private branch exchanges. About 300 telephones have been placed in operation in East Toledo.

TORONTO, OHIO.—The East Springfield Telephone Company has purchased from the Phœnix Telephone Company its exchange at Richwood, including franchise and toll lines to Wintersville. The Wintersville line is now being built and other improvements will be made .

URBANA, OHIO.—The United Telephone Company, of Bellefontaine, has sold a portion of its lines in Champaign County to Murray E. Weymer, of Rosewood. Mr. Weymer owns other lines in the county and the various properties are to be improved and consolidated into a new company, which will be of considerable importance.

HARRISBURG, PA.—The Summit Park Electric Company, of Bethel township, Allegheny County, has been incorporated; capital, $1,000.

LANCASTER, PA.—The Enterprise Telephone and Telegraph Company has been organized at New Holland with a capital of $25,000. It will build a line from New Holland to Reading especially for the use of farmers. The officers are: President, W. M. Stauffer, New Holland; treasurer, E. H. Burkholder, Summersville.

NEWBERRY, S. C.—The Southern Bell Telephone Company has applied for a franchise to put in an exchange at Newberry.

YANKTON, S. D.—At a recent meeting of the Business Men's Club a resolution was adopted to let the contract for an independent telephone system for the city of Yankton to the Messrs. Crumb, of Chicago, for the sum of $13,000, that being the smallest of several bids submitted.

EL PASO, TEX.—The Southern Independent Telephone Company of El Paso has been incorporated; capital stock, $500,000. The incorporators are Annie McElroy Britt, Lorain Miller, J. B. Badger and B. S. Sprague.

SALT LAKE CITY, UTAH.—Two reports were presented to the city council of Butte, Mont., in regard to the franchise asked for by the Rocky Mountain Telephone Company. A majority and a minority report will be presented later on. The company's franchise will expire in about two years more. There is likely to be a hard fight over the matter before the telephone people secure a franchise without paying a large sum for it.

SALT LAKE CITY, UTAH.—Superintendent A. J. Vance, of the Rocky Mountain Bell Telephone Company, has received a set of plans for the new exchange building to be erected in Cheyenne, Wyo., this fall. The advertisement for bids for the construction of the building will be published immediately. The structure will be 25x75 feet, and will be the only fire-proof building in Wyoming. Everything will be of stone, brick, steel, tiling and other non-inflammable material, with no woodwork whatever in its construction. The building is arranged to accommodate a much larger telephone exchange than now exists in Cheyenne.

RICHMOND, VA.—The Richmond, Va., Telephone Company has been granted the right to string a number of wires and cables overhead in order to connect with its new exchange. The arrangement is, however, temporary.

CAMERON, W. VA.—The Augusta Telephone Company has applied to the Town Council of this place for a franchise.

WHEELING, W. VA.—The Bell Company at Wheeling is rearranging its exchange system, giving the entire city direct connection with one central station. Subscribers at Bridgeport, Martin's Ferry and other towns in that vicinity are to be given the same service.

ELECTRIC LIGHT AND POWER.

FLAGSTAFF, ARIZ.—The Grand Cañon Electric Power Company proposes to build a new power plant on Right Angle Creek, a branch of the Colorado River. Surveys for the work are now under way. Mr. Julius Aubineau is president of the company and Mr. D. Babbitt secretary and treasurer.

SAN FRANCISCO, CALIF.—The Standard Electric Company is now supplying electric power for the San Francisco Gas and Electric Company, although in a limited quantity. The distance of transmission is about 145 miles from the Electra power station in Amador County.

SAN FRANCISCO, CALIF.—The Bay Counties Power Company is building a branch from its main electric transmission line at Elmira to Vacaville, Calif. New transformers now being installed at the Vacaville Water & Light Company's sub-station will reduce the high tension current for distribution. E. D. N. Lehe is the manager of the distributing company.

SAN FRANCISCO, CALIF.—It is reported that electric pumping for irrigating rice fields in Texas and Louisiana will be carried on in an extensive way. The Southern Pacific Railroad Company is said to be behind the project. Harvesting machinery and rice mills will also be operated by electric power. The plant will be installed on a 10,000-acre rice plantation in Harris County, Texas.

SAN FRANCISCO, CALIF.—The Richmond Light and Water Company, Richmond, Calif., recently closed a contract with the Bay Counties Power Company for power from its transmission lines. Transformers aggregating 300-kw in capacity have been ordered from the General Electric Company. Richmond is the Santa Fe terminus on San Francisco Bay, with 3,000 inhabitants.

SAN BERNARDINO, CALIF.—The Hellman-Huntington syndicate of Los Angeles has just closed a deal for the purchase of the famous Bear Valley flume, which was built years ago at an enormous expense for the purpose of conveying water from the Bear valley dam on the north side of the San Bernardino mountains, to the orange groves about Redlands and Highlands. It is announced that the syndicate has already selected a site in Santa Anna canyon, 500 feet below the flume, for a power plant and that the flume will be used in connection with this plant.

SAN FRANCISCO, CALIF.—The Golden State Power Company which was recently incorporated in San Francisco, with a capital stock of $10,000,000, has located water rights along the Feather River. It is proposed to develop electric power at various points in Plumas and Butte Counties in California. The first plant is to be installed at Yankee Hill, 186 miles from San Francisco. C. L. Morrill, whose name heads the directorate, has been carrying on preliminary engineering work for five months past, working along the river from Big Bend to Big Meadows. It is proposed to have the first installation completed within two years with a probable capacity of transmitting 60,000 horsepower to San Francisco. The plant farthest away from that city will be 220 miles distant. Frank H. Powers, of San Francisco, represents Eastern investors and H. P. Hussey is connected with the enterprise.

DENVER, COL.—Machine shops, run entirely by electricity, are to be constructed at some points between Denver and Littletown by the George J. Leyner Engineering Works Company. Three electrical 20-ton cranes will be installed. All the larger machines will be run by individual electric motors, and the smaller machines and tools in groups.

EDWARDSVILLE, ILL.—At the last meeting of the City Council, the four bids for a franchise submitted by the Edwardsville Electric Light Company were rejected. The feeling between members of the Council and the electric light company is so intense at present that it is not probable they can get together on a compromise proposition, and in consequence the city will be in darkness after the time of the expiration of the company's present franchise unless the efforts of citizens in the interest of an amicable settlement are successful. The Mayor and a majority of the members of the Council favor municipal ownership.

NOBLESVILLE, IND.—Thomas Griffin and others have purchased the Cromer mill dam north of this city and will at once construct an electric lighting and power plant using water power to generate the electrical energy, which is to be brought to this and other cities.

INDIANAPOLIS, IND.—Lower rates for commercial lighting is the result of the invasion of the downtown districts by the Merchants' Heat and Light Company. The maximum charge permitted by this company is 10 cents per kw-hour. The Indianapolis Light and Power Company charges 12½ but is making contracts at 7½ where the new company competes with it.

AUGUSTA, ME.—The Union River Light & Power Company has been incorporated for the purpose of developing the water power of the Union river and its tributaries, with $1,000,000 capital. The officers are, president, A. Wendal Jackson, of New York City; treasurer, I. L. Halman, Boston, Mass.

PRINCESS ANNE, MD.—The Princess Anne & Deal's Island Light, Power & Railroad Company proposes to construct an electric railway and furnish light, heat and power. It will erect a plant. Mr. H. P. Dashiell is president.

NANTUCKET, MASS.—Mr. J. A. W. Cawley, of Stoneham, Mass., has purchased the Nantucket Gas Light Company and the Nantucket Electric Company and will erect here a new electric plant of about 200 horse-power. Mr. Cawley has entire control of the lighting system.

HELENA, MONT.—The power house of the Helena Light and Power Company was destroyed by fire on Oct. 20· loss, $100,000. It will probably be two weeks before service is resumed by the company.

MIAMISBURG, OHIO.—The Miamisburg Electric Light Company is installing a new arc light machine and will make other improvements to its system.

FINDLAY, OHIO.—The Adams Bros. Bridge Company is completing the installation of an electrical power plant and will operate all machinery by individual motors.

GALLIPOLIS, OHIO.—Risenbach & Maxon, of Coshocton, Ohio, have closed a deal for the purchase of the Gallipolis lighting plant owned by the Clendinen Light Company. The price paid is said to have been $12,500.

FOSTORIA, OHIO.—Prominent citizens are agitating the question of installing a municipal lighting plant in connection with the city water works. At present the city pays $90 per light which is claimed to be too high. The present contract will expire next year.

MIAMISBURG, OHIO.—The Mitchell Wheel Company, which was recently incorporated here, has purchased a site on which it will erect a large plant. It is probable that this plant will be operated by electric power, an independent motor being applied to each machine. Mr. N. J. Catrow is president and Mr. Lee Mitchell, secretary and general manager.

COLUMBUS, OHIO.—J. D. Karns and J. Barber are working in the interests of the Citizen's Heating & Lighting Company which is desirous of securing a franchise to operate its utilities in the southern and western portions of Columbus. The company offers to furnish lighting current at 15 cents per kw-hour and power current for 7½ cents per kw-hour. Discounts ranging from 10 to 30 per cent. are to be allowed on bills paid before the 15th of each month.

SPARTANSBURG, S. C.—J. E. Duval, of Spartansburg, has been awarded a contract to install an electric plant in the Bessemer City, N. C., cotton mill.

BENNETTSVILLE, S. C.—The town council of Bennettsville has provided for a municipal electric lighting plant, the action being taken over the protest of Mayor C. S. McCall.

WACO, TEX.—The Colorado Power and Manufacturing Company, of Waco, has been incorporated; capital stock $12,000. Incorporators: W. W. Seley, R. H. Chatham and S. F. Harrill, of McLennan County, and Rod Oliver, of Dallas.

THE ELECTRIC RAILWAY.

DANIELSON, CONN.—Contracts for extending the Providence and Danielson Electric Street Railway to East Killingly and Elmville have been awarded and construction begun. The Worcester & Connecticut Eastern Railway has practically completed a trolley line between Wauregan and Central Village, and the road will be opened early in November. Work is in progress on the line from Central Village to Moosup, and the entire road from Danielson to Moosup will probably be open for public travel by Jan. 1.

AUGUSTA, GA.—President Jackson, of the Augusta electric railway interests, will probably take up the matter of extending the lines to a number of nearby towns in the near future.

INDIANAPOLIS, IND.—The Huntington and Winona Traction Company, of South Whiley, has filed articles of association. The capital stock is $10,000 which will be increased later on. The directors of the company are George Lee, E. B. Bowers, C. R. Banks, M. W. Webster and E. L. Eberhart.

SEYMOUR, IND.—At a meeting of representative men from Jackson, Bartholomew, Washington and Orange Counties and promoters of the electric railway from Columbus through Seymour and Brownstown to French Lick, a committee was appointed to draft articles of incorporation and also to secure stock subscriptions. The right of way has been obtained through all the counties.

LOUISVILLE, KY.—Articles of incorporation have been filed by a new company which proposes to convert the Louisville, Harods Creek and Westport Railroad into an electric line. The company has $35,000 capital stock, fully paid in, and the officers are Lajon Allen, president; Owen Tyler and Bethel Beach, vice-presidents; W. N. Cox, secretary-treasurer. The work of reconstructing the line is to start at once.

JOPLIN, MO.—The Southwest Missouri electric railway is to be extended from Joplin to Carl Junction, Mo., ten miles north.

ALBANY, N. Y.—The Cross Country Railroad Company, of Brooklyn, with a capital of $250,000, has been incorporated. It proposes to operate a fifteen-mile electric surface railroad with terminii at College Point and Willetts Point. The following are named as the directors: J. F. McClean, A. A. Halsey and Theodore Bernard, all of Brooklyn.

ALBANY, N. Y.—The Brockport, Niagara and Rochester Railway Company, of Brockport, Monroe County, has been incorporated, with a capital of $500,000, to construct and operate an electric railway forty-four miles long from Rochester to Medina. The corporators are Frederick Beck, of Brockport; William Shields, of Waterville; S. J. Spencer, J. L. Bock and Stephen J. O'Gorman, of Buffalo; John Helling, of Rochester; Samuel W. Smith, of Holley, and G. L. Smith, of Glade Run, Penn.

SARATOGA, N. Y.—It was supposed that the strike of the Hudson Valley Railway Company had been settled, but complications have arisen which remove that event as far away as ever and the situation has again assumed a threatening attitude. The strikers at first desired arbitration, but twice rejected propositions to have all questions in dispute settled by a board of arbitrators. It is stated that the company has about decided to close up the road for the fall and winter, running only a sufficient number of cars to maintain its charter.

TOLEDO, OHIO.—The Toledo & Indiana Railway has increased its capital stock from $1,000,000 to $2,500,000.

CLEVELAND, OHIO.—The Lake Shore Electric Railway Company will erect a new sub-station at Vermillion.

CINCINNATI, OHIO.—The Cincinnati Traction Company is planning to build a belt line touching Norwood, East Norwood, Winton Place and Bond Hill.

CINCINNATI, OHIO.—The Ohio Valley Traction Company is making active preparations to commence the building of a line from Covington to Louisville, Ky.

URBANA, OHIO.—The Urbana, Bellefontaine & Northern Railway Company has filed a mortgage for $500,000 given to the Continental Trust Company, of New York. Construction work is being pushed on this line.

COLUMBUS, OHIO.—Plans have been completed for the new power house to be erected near Columbus by the Scioto Valley Traction Company. Contracts will be closed in the near future for the electrical equipment.

LIMA, OHIO.—It is announced that the Western Ohio Railway will commence work of grading this fall on the section from Lima to Findlay. When this is completed there will be a through line from Cincinnati to Toledo.

COLUMBUS. OHIO.—It is stated that the Appleyard syndicate is planning another interurban road out of Columbus to extend up Alum Creek Valley to Central College, Galena and Sunbury. A route into the city will also be secured, it is said.

SPRINGFIELD, OHIO.—The Dayton, Springfield & Urbana Railway will increase its capital stock from $750,000 to $1,500,000. Extensive improvements will be made to the system, and the line from Dayton to Springfield will be double tracked.

STEUBENVILLE, OHIO.—The Steubenville, Mingo & Ohio Valley Railway which has been acquired by the Wheeling Traction Company is to be improved and extended. A large power house will be built at Brilliant. A generating unit has been ordered.

CLEVELAND, OHIO.—It is reported that the Pomeroy-Mandelbaum syndicate is preparing for a merger of the Cleveland & Southern Railway with the Cleveland, Elyria & Western Railway. From an operating standpoint the two roads are at present identical.

SPRINGFIELD, OHIO.—Boston capitalists have agreed to take the $2,225,000 bond issue of the Springfield & Washington Traction Company which proposes to build from Springfield to Washington C. H. George H. Frye, of Springfield, is the chief promoter.

RIPLEY, OHIO.—The Columbus & Ohio River Railway has been organized by G. Bambach, E. E. Galbreath, A. White and others of Ripley and Cincinnati, to build a combined steam and electric road from Aberdeen down the Ohio River to Ripley, thence northerly to Georgetown, Hillsboro and Columbus. It is the plan to operate electric cars, freight trains to be steam hauled.

CINCINNATI, OHIO.—The Norwood, Oakley, Madisonville & Red Bank Traction Company has been organized, with $100,000 capital stock, by David Davis, Captain Peter Eichels, L. M. Strafer, B. W. Harrison and A. E. Carr. The road will run from Norwood to Red Bank, connecting with the Cincinnati & Norwood and the Rapid Transit Railway at Oakley and the East End line at Red Bank.

ZANESVILLE, OHIO.—The organization of the Zanesville Street Railway & Electric Light Company has been effected by the parties who purchased the street railway and lighting plants from a Boston syndicate. The new officers are F. A. Durban, Zanesville, president; H. M. Byllesby, Chicago, vice-president; W. D. Breed, Cincinnati, treasurer; W. A. Gibbs, Zanesville, secretary and general manager. The property will be improved and extended.

CLEVELAND, OHIO.—An electric sleeping car service between Cleveland and Detroit will soon be established by the Lake Shore electric railway. The company has awarded the contract for the building of several sleepers to the Kuhlman Car Company of this city, and when they are completed a fast night service will be started. It is thought that the run can be made in about ten hours so that one can take a sleeper here at 9 p. m. and be in Detroit at 7 o'clock the next morning. The cars are to be of the same class as up-to-date Pullmans.

CLEVELAND, OHIO.—The Cleveland syndicate which financed the Toledo & Western Railway and the Cleveland, Painesville & Ashtabula Railway has taken up the financing of another enterprise, forming a new link in the chain of lines paralleling the Lake Shore & Michigan Southern Railway from Buffalo to Chicago. Both the roads above mentioned are on this route while the new road which will be known as the Buffalo, Dunkirk & Western Railway, will close up another important gap. The chief promoters are Hon. Luther Allen, J. E. Latimer and J. W. Holcomb. The line will extend from Westfield to Buffalo, a distance of fifty miles. The road will cost about $2,000,000.

READING, PA.—The Electric Equipment Company, of this city, has secured 51 per cent of the stock of the Elmira & Waverly Railroad Company, New York, and is making preparations to equip the road. The remainder of the stock is held by capitalists in Elmira, N. Y. The New York street railway commissioners have heretofore refused the necessary permission to proceed with the line because of alleged insufficient capital.

MEMPHIS, TENN.—The Gulf Shore Electric Railway Company has been incorporated to build a 20-mile electric railway between Henderson's Point, on Bay St. Louis, to Point Cadet, near Biloxi, Miss.

SALT LAKE CITY, UTAH.—From reliable source it is learned that the Pacific Electric Railway Company will at once build its line to Whittier, Calif.

SALT LAKE CITY, UTAH.—Steps have been taken to secure a branch of the Salt Lake & Suburban Railway connecting with the company's lines at Sixteenth South Street and extending to Mill Creek canyon.

RICHMOND, VA.—The Richmond and Petersburg electric railway has been bought by the Virginia Passenger and Power Company, of Richmond, and the latter will take formal possession about the middle of November.

NEW INDUSTRIAL COMPANIES.

THE MERCHANTS' ELECTRIC COMPANY has been incorporated at Wilmington, Del., with a capital stock of $150,000.

THE ELECTRICAL REFLECTOR COMPANY, of New York; capital $10,000, has been incorporated. Directors: W. A. Schiffer, E. A. Kerbs and C. S. Gans, New York.

THE CHAMPION TROLLEY-HARP COMPANY, of Philadelphia, has been incorporated under the laws of Delaware to manufacture an improved trolley harp. The capital stock is $130,000.

THE EICKEMEYER ELECTRIC PUMPING COMPANY has been incorporated at Jersey City, N. J.; capital stock $50,000. Incorporators: Carl Eickemeyer, John F. Avery, S. R. Bullock.

THE CLARK AUTOMATIC TELEPHONE COMPANY, of Providence, R. I., it is stated, will organize a sub-company, with Sioux City, Ia., as headquarters, to do business in Iowa and Nebraska.

THE ARCHER & PANCOAST COMPANY, New York (gas and electric light fixtures), has been incorporated, capital $10,000. Directors: J. H. Selmes and W. E. Curtis, New York; C. P. Davis, Hartford, Conn.

THE PENNSYLVANIA EQUIPMENT COMPANY, Camden, N. J., has been incorporated to manufacture electric equipments, etc.; capital $25,000. Incorporators: Benj. Beerwald, Benj. L. Cates and Aaron A. McCray.

THE ELECTRIC CONSTRUCTION & MACHINE COMPANY has been organized at Moline, Ill., with a capital stock of $25,000. Messrs. Thomas H. Burtchaell and Herman Schmidt, of Moline, are prominent among the incorporators.

THE AMERICAN DEVICE MANUFACTURING COMPANY, of New York, has been incorporated to manufacture railway and electric supplies; capital $100,000. Directors: Nelson Stafford, Brooklyn; A. N. Stafford, East Orange, N. J., and Edgar Beekman, New York.

THE UNITED STATES ELECTRIC COMPANY, of Jersey City, has been incorporated to manufacture electrical devices; capital, $25,000. Incorporators: George C. Wilfore, New Brighton, S. I.; Henry McDonough, Montclair, and Clarence Kelsey, Jersey City.

THE PROTECTIVE THIRD RAIL ELECTRIC BLOCK AND SIGNAL COMPANY, of New York, has been incorporated at Albany with a capital stock of $500,000. The directors are Frederick Brotherhood, A. M. Lowry, Henry Lehman, H. F. Clinton and Dennis A. Kennelly, all of New York City.

THE AMERICAN MOTOR CARRIAGE COMPANY, Cleveland, Ohio, has been incorporated under the Delaware laws with a capital stock of $500,000. The incorporators are Frank H. Ginn, Albert E. Green and J. M. Garfield. The company will manufacture gasoline and electric automobiles. It will erect a large factory in Cleveland.

THE J. & M. MANUFACTURING COMPANY has been incorporated at Augusta, Me., for the purpose of manufacturing and dealing in engines, storage batteries and electric appliances; capital stock $1,000,000, of which $15,000 is paid in: president, Fletcher W. Jewell, Boston, Mass.; treasurer, William F. Miller, Boston, Mass.

LEGAL.

LEGALITY OF INFORMATION BY TELEPHONE.—The Supreme Court of Iowa recently decided that when a judge notifies an attorney over a telephone line that he has decided a case a certain way, the attorney has a right to rely on the telephone having accurately transmitted the information.

EDISON LAMP SOCKETS.—An injunction has been issued against J. F. Buchanan, of Philadelphia, in a suit filed by the General Electric Company on the Tournier patent, No. 559,232, April 28, 1896, the particular infringement being the sale of certain Edison lamp sockets manufactured by the New England Electric Manufacturing Company, of Boston, Mass.

COLUMBIA TELEPHONE MFG. CO.—J. F. Furman has filed a petition in the U. S. District Court declaring bankrupt the Columbia Telephone Manufacturing Company, of Ottawa, Ohio, and asking for the appointment of a receiver. The Security Trust Company, of Toledo, was appointed. Following this step, an injunction was secured restraining the sheriff from disposing of the company's plant and goods. It is believed the company will be reorganized.

SUBWAYS PART OF EQUIPMENT.—According to Justice O'Gorman of the N. Y. Supreme Court, the rapid transit subway contractors must pay for the electric ducts that are being installed in the side walls of the Rapid Transit tunnel. John B. McDonald applied to the court for a writ of mandamus compelling Controller Grout to pay $400,000 already expended on the ducts. If the ruling stands, the city will save $1,200,000, the cost of the ducts. Mr. McDonald contended that the ducts or tubes were part of the construction of the tunnel. The Controller refused to pay the voucher for $400,000 on the ground that the ducts were part of the underground road's equipment. The $400,000 has been expended prior to July 1 of this year. The Board of Rapid Transit Commissioners decided by a formal vote that the city ought to pay the $1,200,000. Justice O'Gorman says: "This action of the Rapid Transit Board cannot be upheld. While acting within the authorty delegated to them, their actions will not be interfered with, but where it is claimed that they have gone beyond the scope of their authority, their conduct will be reviewed by the courts. Concededly, under the statute, the commissioners have no right or power to designate as work of construction what the Legislature has declared to be equipment." "Equipment" is defined in the decision as including all such things as motors, cars, power houses, ways, wires, and conduits—"all the devices used in the transmission of power."

PERSONAL.

MR. CHARLES A. CHAPMAN, consulting engineer, is changing his address and will be hereafter at 1040-1042 No. 204 Dearborn Street, Chicago.

DR. A. E. KENNELLY has just returned to New York from a successful cable laying expedition in Mexican waters, and has proceeded to Harvard University to take up his duties as professor of electrical engineering.

MISS LEILA MORSE, grand-daughter of Prof. Morse, sang last week at the dedication of the Kaiserin Augusta Institute, in Berlin, and was called up and complimented by the Empress, who mentioned having heard her at a school concert a few years ago.

DR. F. A. C. PERRINE, president of the Stanley Electric Mfg. Company, and Mr. Ray D. Lillibridge, were guests of the Michigan Lake Superior Power Company at the celebration of the opening of the 60,000-hp canal and power house at Sault Ste. Marie, October 25.

MAJOR FLOOD-PAGE, of the Marconi Wireless Telegraph interests in England, is to be one of the representatives of the London Chamber of Commerce at the opening of the new home of the New York Chamber of Commerce next month. He is now in New York City.

PROFESSOR MORGAN BROOKS, the head of the Electrical Engineering Department of the University of Illinois, Urbana, and a party of seniors, consisting of Edward T. Buell, L. Dolkart, J. F. Duffy, M. D. French, R. W. Gaston and F. W. Rose, last week made an inspection tour of things electrical in and about Chicago.

MRS. LESLIE CARTER, in going about the country, has found great inconvenience in the various dressing rooms at the theatres where she performs,

and has consequently had built a portable dressing room. One essential feature of it is a little electric heater. Mrs. Carter says that the room is a great saving of wear and worry.

MR. JOHN F. KELLY, of the Stanley Electric Mfg. Company, and family, have just returned from a long trip abroad.

MR. THEODORE BERAN, of the General Electric Company's headquarter's staff in New York City, is home again from Europe.

MR. D. M. STEWARD, the veteran lava insulator manufacturer, of Chattanooga, Tenn., is now in New York City to introduce a new form of cleansing material.

MESSRS. DAVIES AND EVANS, engineers of the Pwllbach Colliery Company, of Swansea, South Wales, are now in the United States studying electrical machinery, etc., which it is proposed will be installed very shortly in their plant.

COL. ALEXANDER GORDON, chairman of the Board of Directors of the Niles-Bement-Pond Company, who is also largely interested in the German Niles Tool Works, of Berlin, arrived from Europe this week on the Kaiser Wilhelm der Grosse.

COL. W. A. ROEBLING, after suffering for thirty years as the direct result of caisson fever, contracted during the building of the piers of the Brooklyn Bridge, submitted to an operation in the Roosevelt Hospital last week, which is thought will restore him to physical comfort unknown during this long period. He is going along very nicely.

MR. A. W. McLIMONT, formerly president of the Federal Electric Company, 141 Broadway, New York, has been appointed general manager of the newly formed Monterey Electric Railway Company, which is to build and operate an electric traction system in the city of Monterey, Mexico. Mr. McLimont will have charge of the construction and management of the road.

MR. W. C. WHITNEY, who has been spending the past five weeks at his lodge in Yorkshire, England, returned on Sunday last on the White Star liner Celtic. The party that sailed with him on September 5 included his son, Harry Payne Whitney, Mr. and Mrs. H. B. Duryea, H. Yale Dolan and Mrs. Thomas Hastings, all of whom returned with Mr. Whitney, except Harry Payne Whitney, who arrived recently on the Oceanic.

MR. C. O. POOLE, who recently resigned his position as electrical engineer with the Standard Electric Company in San Francisco and went East, has been appointed manager of the Stanley Electric Manufacturing Company's agency in Denver. Mr. Poole had much to do with the successful completion of the Standard transmission system which is now in commercial operation as far as San Francisco. He was for some years in a responsible position with the San Francisco Gas & Electric Company.

MR. J. C. BELDEN, formerly sales manager for the Kellogg Switchboard and Supply Company, of Chicago, and previously purchasing agent, has left the company and gone into business for himself under the style of the Belden Mfg. Co., at 118 Michigan Street, Chicago. He began with the Kellogg interests when they started at Highland Park and had been with them ever since. A specialty with the new concern is magnet wire. Mr. Belden has Mr. Albert Bentler with him as superintendent.

MR. E. ZORRILLA, general manager of the Spanish-American Light and Power Company, Consolidated, of Havana, Cuba, of which concern Mr. T. J. Hayward, of Bartlett, Hayward & Co., of Baltimore, Md., and 100 Broadway, New York, is the president, is now on a short visit to the United States. As already mentioned in the ELECTRICAL WORLD AND ENGINEER, the company's operations are to be considerably extended and a quantity of new equipment will be required. Mr. Zorrilla may be found downtown at the company's offices, 100 Broadway.

MR. E. H. BEACHAM, of New York, recently connected with Messrs. Sanderson and Porter in the construction of the new street railway and electric lighting plant for the Peekskill Lighting and Railroad Company, has accepted an engineering position with the Levering & Garrigues Company, of New York, engineers and contractors for bridges, buildings and general structural iron work. Mr. Beacham secured his early training in the shops of the Thomson-Houston Company at Lynn, Mass., and for twelve years past has been engaged in construction work in both the street railway and electric lighting fields.

MR. THOS. E. MITTEN.—Advices from Milwaukee say: It is reported here that Thomas E. Mitten, who was for several years General Superintendent of the Milwaukee Street Railway system, and who is now general manager of the International Traction Company, of Buffalo, N. Y., is considering a proposition which may place him at the head of the Metropolitan Railway Company, of New York. The New York position would place Mr. Mitten under President Vreeland, who, it is said, is contemplating a European tour to cover a period of two years. Mr. Mitten to be in charge of affairs during Mr. Vreeland's absence. Before coming to Milwaukee Mr. Mitten was connected with the Denver system.

MR. EMILIO DYSTERUD, chief engineer of the Compania de Luz Electrica y Firaza Mortriz de Monterey (the Monterey Electric Light and Power Company), of Monterey, Mexico, has been in the United States for several weeks past studying electrical machinery, with a view to determining as to equipment which it is intended to further install in the company's plant, as such may be extended shortly from 800 hp to 2,000 hp. He left New York Wednesday for Niagara, Buffalo, Toronto, Pittsburg, Cincinnati, St. Louis, Chicago and Austin, Tex., from which place he will return direct to Monterey, arriving in that Mexican city about November 12. It is anticipated that very shortly after his return some substantial contracts for machinery, etc., will be placed here.

MR. W. K. PALMER, consulting engineer, 401 New York Life Building, Kansas City, Mo., has been retained as consulting engineer for the American Carbolite Company, which has recently been organized for the purpose of building a plant at Constantine, Mich., for the manufacture of calcium carbide by a new process. Mr. Palmer and assistants are now in Chicago engaged in designing the electrical furnaces and special machinery required in the plant, and preparing plans for the arrangement of the equipment and for the steel building. The plant embodies many novel features—electrical, mechanical and structural—because of the unusual character of the process. Electrical power will be employed throughout the works.

NEW YORK ELECTRICAL SOCIETY.—At the regular meeting on October 22, the following members were elected: A. H. Ackerman, N. Y. Edison Co., 53 Duane Street, N. Y.; Frank F. Thompson, J. G. White & Co., 29 Broadway, N. Y.; Orosco C. Woolson, 118 Havemeyer Building, N. Y.; E. W. Hazazer, 8 Dover Street, N. Y.; C. R. Newman, Pasaic, N. J.; John H. Dale, 22 Thames Street, N. Y.; Charles H. Sinnett, 463 West Street, N. Y.; Olin Beecher Greene, 93 Liberty Street, N. Y.; A. F. Stanley, 170 Broadway, N. Y.; Geo. L. Patterson, 93 Liberty Street, N. Y.; Brice A. Frey, Signal Office, Governor's Island, N. Y.; Berry Riphael, Astor Court Building, 18 West 34th Street, N. Y.; Gustave A. Brackly, 874 Broadway, N. Y.; John L. Streever, 85 Borden Ave., Long Island City, N. Y.; R. Halliday Nexsen, 302 St. James Place, Brooklyn, N. Y.; Geo. Greenwood, Apartado 91 Jalapa V, Mexico; Henry A. Sheuplein, 497 Lexington Avenue, N. Y.; G. T. Luckett, 506 West 151st St., N. Y.; Severn D. Sprong, 818 Marcy Avenue, Brooklyn, N. Y.; William T. Dempsey, 1273 Bushwick Ave., Brooklyn, N. Y.; F. Moreton Jack, 1330 Bushwick Ave., Brooklyn, N. Y.; E. A. Harley, 80th Street and East End Ave, N. Y.

Trade Notes.

THE NATIONAL ELECTRIC LAMP COMPANY will build a plant at Warren, Ohio, and will employ 500 hands.

THE STANDARD ELECTRIC MANUFACTURING COMPANY, of Niles, Ohio, has increased its capital stock from $30,000 to $75,000.

S. E. I. COMPANY, J. W. Eager, manager, has moved from 219 Walton Street to the Hall & McChesney Building, corner South Franklin and Jefferson Streets, Syracuse, N. Y.

THE ELECTRIC MOTOR & EQUIPMENT COMPANY, of 13 Beaver Street, Newark, N. J., has secured the contract for the electrical equipment of the new city hall in Newark, the price being $59,200.

THE CENTRAL ELECTRIC COMPANY, of Chicago, wishes to call attention to Columbia lamps. Any buyer of incandescent lamps will be sent, upon request, an attractive pamphlet entitled "That Question of Light."

THE NATIONAL-ACME MFG. COMPANY, of Cleveland, Ohio, maker of the Acme automatic tools, screw slotters, etc., reports the opening of its New England office at 45 Oliver Street, Boston, in charge of Mr. M. M. Brunner.

THE *TELEPHONE MAGAZINE* has passed into the control of the Trade Press Company, of Chicago. This company publishes the *Produce News*, the *Dry Goods Reporter* and the *Investor*. C. E. Kammeyer will still be connected with the paper.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is sending out circulars illustrating and describing its three styles of Newgard combined waterproof globe and receptacle. It claims for it that it is the only thing that "will make a brewery or wet job, dry."

NOTICE OF REMOVAL.—The offices of Messrs. F. S. Pearson, L. J. Hirt, W. P. Plummer, H. L. Cooper and R. D. Mershon, as well as of the Brazilian, Mexican and West Indian interests they represent, will hereafter be at the Columbia Building, 29 Broadway, New York.

REMOVAL.—The Pettingell-Andrews Company, Boston, Mass., announces the removal to its new building at the corner of Pearl Street and Atlantic Avenue, which location is in Boston's electrical center. The company has in its new quarters a large and excellently equipped supply house.

DIAMOND CHEMICAL WORKS, of 58 South Clinton Street, Chicago, who manufacture the Stubenrausch "Diamond" commutator compound, report being very busy filling orders. They have a large demand for their product. Their works have just been removed to 547 School Street, where they have better facilities for manufacturing than formerly.

THE WHEELER REFLECTOR COMPANY, of Boston, will remove, about November 1st, to 156 Pearl Street. It was forced to make this move as in its present quarters it was unable to fill the large orders which have been pouring in upon it. With largely increased room and new and improved machinery which it will install, it will be enabled to supply the demand for its fixtures and shades promptly.

AKRON BULLETINS.—The Akron Electric Manufacturing Company, Akron, Ohio, has issued three well printed and handsomely illustrated bulletins, the subjects being respectively "Direct-Current Motors and Generators," "Direct-Current Engine-Tube Generators," and "Invertable Type Open and Enclosed Generators and Motors." The latter bulletin is accompanied by a handsome illuminated engraving on a card of a machine of the enclosed type. The same company has also issued a reprint from the Proceedings of the Engineering Society of Western Pennsylvania, of an article by Mr. F. B. Duncan on "Electrical Equipment in Modern Machine Shop Practice." This contains some valuable data on the power required to run various kinds of tools.

CORRESPONDENCE INSTRUCTION SCANDAL.—It is reported from Scranton that a fake correspondence school there has been choked off by the action of the Government, the postal authorities causing the arrest of four of the managers for fraudulent use of the mails. They had garnered $90,000 in two years from about 6,000 patrons, under specious offers of cheap or free tuition, with all kinds of "chromos" thrown in, but had no real instructors and used stereotyped corrections of instruction papers. Such excellent institutions as the International Correspondence Schools of Scranton are to be congratulated on being freed from the dishonest competition of a concern of this character, whose object in locating at that place is obvious.

UP-TO-DATE READING.—One of the most authoritative and at the same time one of the most interesting narratives of the "Volcanic Eruptions in the West Indies," is contained in the report made by scientists sent out by the Royal Society to investigate the phenomena, which is published in *The*

Living Age for September 27. The distinguished explorer, Dr. Sven Hedin, has written for the *Geographical Journal* an account of his last three years' exploration in Central Asia. It will be found in *The Living Age* of the same date.

EUGENE MUNSELL & CO., who are pioneers in everything connected with the mica business, have recently begun the manufacture of a mica chimney, for incandescent gas burners, which is superior in many respects to anything heretofore offered in that line. It is known as "Warren's Folding Interlocking Mica Chimney," and application has been made for a patent on its unique and yet simple style of construction. The chimney is packed and sold flat, like a sheet of paper, and it can be formed into a cylinder as easily as a sheet of paper can be rolled up, the edges interlocking, as implied by the name. This makes it possible to clean the chimney, when necessary, easily and thoroughly, which cannot be done with the ordinary mica chimney. It furthermore, by its peculiar construction, transmits 10 per cent more light than any other mica chimney and casts no shadow. In addition to these good selling points, there is the further advatage to the dealer that the shipping weight of these chimneys is one-fifth less than that of others, and that they take up but little space on shelf or in store room—a whole gross occupying less space than two dozen of the old-fashioned chimneys. A descriptive price list will be sent upon application.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 21, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

711,465. TANK; H. Bradshaw, Chicago, Ill. App. filed June 13, 1902. The tank is constructed to recieve cells of battery and to be sunk in the earth.

711,481. STORAGE BATTERY PLATE; N. T. Daboll, New London, Conn. App. filed Feb. 19, 1902. The plate consists of wire gauze coated with finely divided carbon and this coated with white lead.

711,488. SUPPORTING AND LIFTING MECHANISM FOR SECONDARY BATTERY PLATES. App. filed Feb. 24, 1902. The frame comprises a two-part beam having a bent rod and two transverse beams having hooks arranged for ready engagement with the two-part frame.

711,520. ELECTRIC MOTOR FOR VEHICLES; H. G. Osburn, Hoboken, N. J. App. filed May 6, 1901. The armature is carried by the hub and the field magnet by the vehicle frame.

711,532. INCANDESCENT ELECTRIC LAMP; J. J. Rooney, Scarsdale, N. Y. App. filed Nov. 14, 1901. A multi-filament lamp having a base adapted for an ordinary socket.

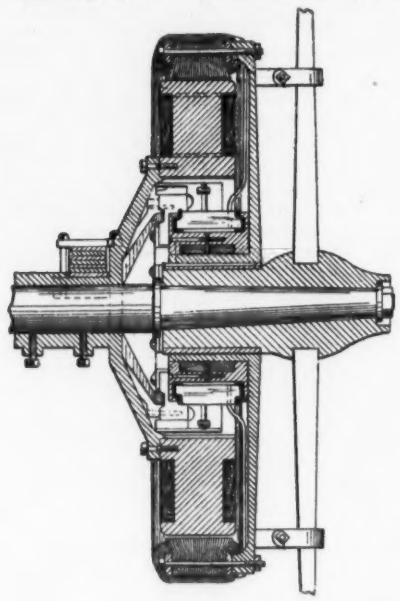
711,537. STORAGE BATTERY; F. Sedgwick, Chicago, Ill. App. filed Aug. 2, 1902. The electrode is composed of film-like layers of lead foil, each having small closely arranged perforations sufficiently numerous and minute to produce in the assembled whole a cellular mass capable of capillary action.

711,543. FUSE BOX; J. C. Stewart and W. Horn, Newark, Ohio. App. filed April 28, 1902. Details.

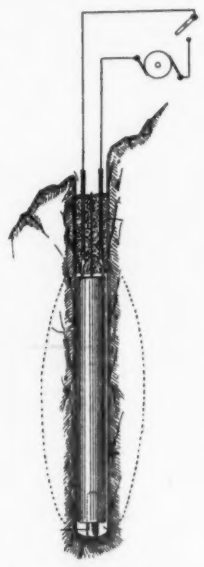
711,545. ART OF BLASTING; G. Thompson, Elizabeth, N. J. App. filed May 28, 1902. An electric furnace is introduced into the blasting hole and a current passed until the excessive heat disrupts the rock.

711,556. TELEPHONE SWITCHBOARD PLUG; H. P. Clausen, Chicago, Ill. App. filed April 13, 1901. (See Current News and Notes.)

711,567. CARBON HOLDER FOR ELECTRIC ARC LAMPS; J. A. Heany, Philadelphia, Pa. App. filed March 12, 1902. A spring socket formed of a strip of metal bent into clyindrical shape with a space between its edges and a tongue formed at one end to receive a post for electrical connection.



711,520.—Electric Motor for Vehicles.



711,545.—Art of Blasting.

711,588. INCLOSURE FOR TELEPHONES; A. J. Parke, Boston, Mass. App. filed May 23, 1901. (See Current News and Notes.)

711,589. INCLOSURE FOR TELEPHONES; A. J. Parke, Boston, Mass. App. filed July 13, 1901. (See Current News and Notes.)

711,610. SHOW CASE BRACKET; G. C. Wright, Cleveland, Ohio. App. filed May 10, 1902. An adjustable bracket to hold an electric light.

711,614. GAS BATTERY; O. Britzke, St. Petersburg, Russia. App. filed Jan. 17, 1901. A cell of refractory material having metal plates on opposite sides and a plate saturated with an electrolyte and dividing the space between the two plates into two passages and means for circulating hot gases through the passages.

711,615. MOUTHPIECE FOR TELEPHONE-TRANSMITTERS OR SPEAKING TUBES; J. W. Brown, Philadelphia, Pa. App. filed Jan. 9, 1902. (See Current News and Notes.)

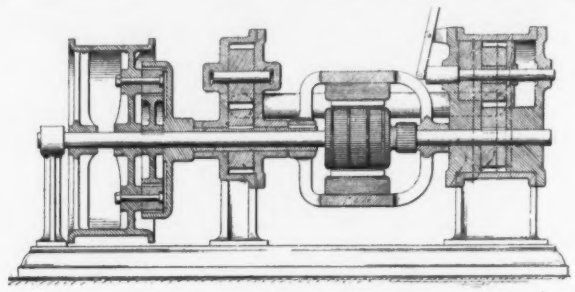
711,624. CANDLE HOLDER; M. Hammerstein, Berlin, Germany. App. filed Oct. 25, 1901. The holder contains a battery and is provided with a cover which carries an electric lamp which is thrown into view and into circuit when the cover is raised.

711,629. INSULATOR; C. Hobart, Philadelphia, Pa. App. filed March 6, 1902. A knob having a groove at the side to receive the wire and a wedge to hold it in place.

711,640. TELEPHONE-RECEIVER; W. M. Miner, Plainfield, N. J. App. filed March 7, 1901. (See Current News and Notes.)

711,649. SECONDARY ELECTRIC CLOCK; J. J. Stockall, Sr., London, Eng. App. filed Feb. 26, 1901. Details.

711,663. MECHANICAL MOVEMENT; F. E. Herdman, Winnetka, Ill. App. filed April 14, 1902. A rotating armature and field, a hydraulic apparatus connected between them and means to vary the speed of the hydraulic apparatus to vary the proportionate speed of the motor elements without altering the speed of the motor.



711,663.—Mechanical Movement.

711,667. MEANS FOR REGULATING ELECTRIC MOTORS; R. Lundell, New York, N. Y. App. filed May 10, 1902. A controller for changing the strength and character of the field magnet of the motor in such a manner that the field strength is practically independent of the armature for the slower current, but highly responsive to variations in the armature current for the higher speeds.

711,710. STORAGE BATTERY; D. E. Wiseman, Chicago, Ill. App. filed March 12, 1901. A ribbon of lead having pockets therein is bent back and forth to form the plate.

711,743. TELAUTOMOTOR; H. Shoemaker, Philadelphia, Pa. App. filed April 12, 1901. A wireless telegraph arrangement is used to control the mechanism of a marine torpedo.

711,790. AUTOMATIC ELECTRIC CIRCUIT CONTROLLER; J. Sachs, Hartford, Conn. App. filed Oct. 5, 1900. A series of fuses are arranged to be cut out in succession as and when a given number of lamps in circuit is exceeded.

711,827 ELECTRIC HEATER FOR DENTAL PURPOSES; J. Cook and J. M. Pumerville, Michigan City, Ind. App. filed July 15, 1901. The heater is used for drying a current of air which is to be directed into the cavities of teeth.

711,867. PORTABLE ELECTRICALLY ILLUMINATED SIGN; H. S. Kemp, Richmond, Va. App. filed Feb. 25, 1902. A street car sign which can be readily changed without deranging the circuits.

711,868. ILLUMINATED SIGN; H. S. Kemp, Richmond, Va. App. filed Feb. 25, 1902. A modification of the preceding patent.

711,873. ELECTRIC COMMUTATOR; W. Loewen, Breslau, Germany. App. filed March 22, 1902. A mercury switch consisting of a closed vessel on the hour glass plan.

711,893. ELECTRIC SIGNALLING APPARATUS; A. F. Hauss, Baltimore, Md. App. filed Jan. 30, 1902. A circuit closing and opening device is arranged to automatically open the circuit after the transmitting mechanism is operated, to avoid waste of battery and accidental change of the signal.

711,917. STORAGE BATTERY PLATE; E. H. Winkes, Buffalo, N. Y. App. filed April 25, 1902. A long sheet of lead folded back and forth to present numerous corrugations, each of which is cut through for a portion of its width and provided with spacing bosses to separate the folds.

711,921. FUSE; F. B. Cook, Chicago, Ill. App. filed July 29, 1896. An insulating tube containing a fuse and suspended and supported across two conductors.